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ABSTRACT

The 1990 conference was designed to afford an opportunity to assess the dynamic developments in telecommunications during the 1980s and to gain perspectives on the ways in which telecommunications can most effectively be integrated into society during the 1990s. These proceedings contain more than 100 papers presented during sessions addressing the following topics: connectivity, marketplace issues, high definition television, major issues in world communication, the impact of telecommunications technology on intellectual property rights, regional communications in a global setting, the information revolution in the Pacific rim, regulatory issues, Pacific satellite proposals and developments, fiber optics technology and systems, broadband, Very Small Aperture Terminal (VSAT) technology, mobile communication, distance learning technology and techniques, business applications, information providers, transborder applications, telecommunications and the travel industry, rural and remote applications of telecommunications, telework, and electronic trade. Most of the papers include references. (GL)

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12th Annual Conference

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Edited by Dan J. Wedemeyer and Mark D. Lofstrom

January 14–17, 1990
Hilton Hawaiian Village / Honolulu, Hawaii

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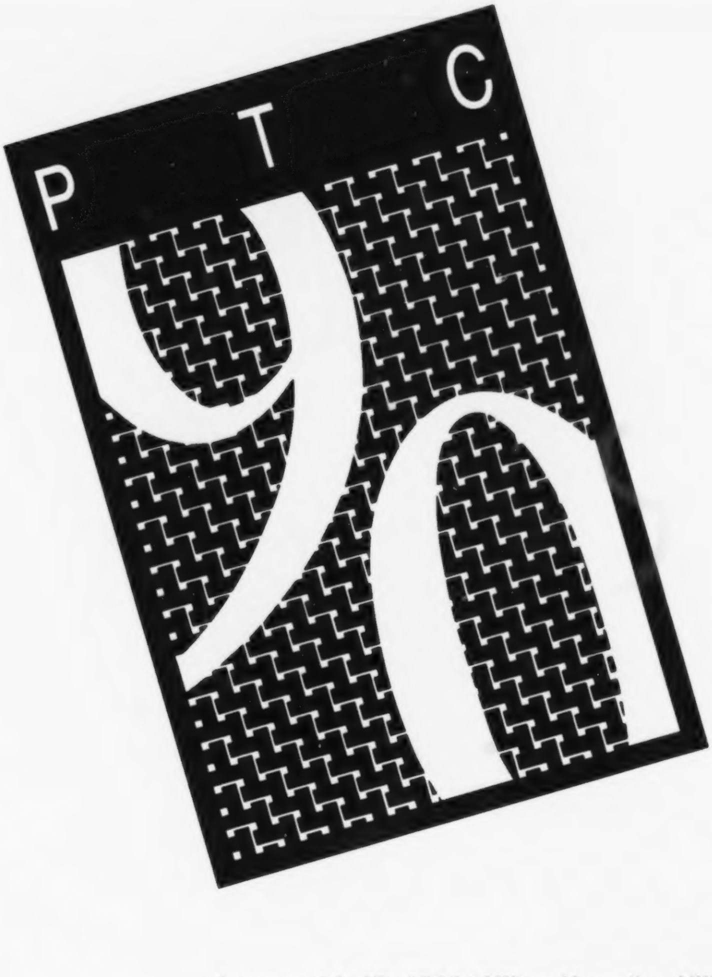
Proceedings

Pacific Telecommunications: Weaving the Technological and Social Fabric

Edited by Dan J. Wedemeyer and Mark D. Lofstrom



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PTC'90 is organized by the Pacific Telecommunications Council, an international non-governmental, non-profit organization. The council is regional in nature, embracing members from all the countries that play a role in the development of Pacific telecommunications. Its members are dedicated to promoting the understanding and beneficial use of telecommunications throughout the entire Pacific Hemisphere--North, Central, and South America; East, South and Southeast Asia; Australia; New Zealand, Melanesia, Micronesia and Polynesia.

FOREWORD

During the past decade, Pacific telecommunications and PTC both underwent dynamic growth. Policy issues, technologies, and applications brought far-reaching changes to telecommunications throughout the region. Ten years ago, for instance, the full impact of deregulation in the U.S., the strong international focus on technical standards occasioned by the development of ISDN and HDTV, and the explosion of demand for mobile communications were only the specialized concerns of telecommunications professionals. Today, the business and daily press regularly report on telecommunications developments, and many of the changes, once understood only by a small group of professionals, occupy the attention of policymakers, academics, business leaders, investors, and managers in all types of organizations.

The full impact of the information age is beginning to be felt globally. We see it in companies seeking to raise productivity and internationalize operations; in nations, like Singapore, seeking a competitive advantage through development of export-oriented information services; in government offices that set policy on trade and economic activity; among researchers; and among executives and entrepreneurs who are eager to offer and innovate new services.

Not surprisingly then, PTC's annual conference also grew in importance and stature throughout the decade. The number of papers presented by speakers from throughout the region increased dramatically, as did the quality of those presentations and conference attendance. This year's conference sets new records for the number of papers presented and the number of professionals attending. We also believe that the quality of papers sets a new standard of excellence.

Titled "Weaving the Technological and Social Fabric," PTC '90 affords an opportunity to assess the dynamic developments in telecommunications during the 1980s and to gain perspectives on the ways in which telecommunications can most effectively be integrated into society during the 1990s.

During the decade ahead, Pacific telecommunications will continue to grow dynamically, as will the number and complexity of issues, technologies, and applications. New challenges will continue to emerge, and old ones will persist. The main challenges that will likely preoccupy the industry and its professionals will increasingly be those related to connectivity on a global scale.

Economic, social, and political changes in Europe will certainly be important factors affecting the development of telecommunications in the Pacific. These topics will be explored by several leaders from Europe speaking at PTC '90. So too will changes in Hong Kong; the PRC's ambitious telecommunications investment plans; continued development of information economies among the Asian NIEs; liberalization of regulatory regimes in New Zealand, Canada, Korea, Australia, and elsewhere; internationalization of services; and, extensions of satellite and fiber optic networks. As the PTC '90 papers start to indicate, new markets for mobile communications; the need to reach consensus on international standards for HDTV; and, opportunities for videotext are among other developments to watch during the decade ahead. Of course, we can hardly begin to summarize here what nearly 150 speakers will present over the four days of PTC '90. We invite you to explore the richness of the conference from your own perspective.

This year, a companion volume has been added in order to provide participants with a brief guide to the concurrent sessions and the papers presented in each. Because of the sheer number of speakers and topics that PTC's annual conference has come to encompass, we realized that participants might find such a guide helpful.

As has been the PTC tradition for 12 years, we dedicate this volume to the paper contributors, the Conference Committee, and to the PTC Directors, staff, and student volunteers without whom organizing and presenting the annual conference would not be possible.

Mahalo and Aloha,

Dan J. Wedemeyer
Mark D. Lofstrom
Editors
Honolulu, 1990

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The Telecommunications Challanges of Distance Education

Dr. James A. Maraj

President of
The Commonwealth of Learning

ABSTRACT

The role of distance education is to assist with human resource development through extending the opportunity to learn to those beyond the reach of conventional education. The growth of distance education is being impeded by inadequate access to suitable educational materials and by problems of telecommunications availability and cost. The Commonwealth of Learning has recently been established to assist the educational institutions of the forty-nine Commonwealth member nations with overcoming these challenges through increased co-operation and sharing of resources.

In many parts of the world, large numbers of people do not have access to the range of educational facilities that those who live in the more developed countries have come to expect as a right. They do not have conveniently available schools, community colleges, technical institutes or universities, filled with well trained staff and adequate educational tools. Even in the more developed world, distance and geographic obstacles can make it difficult for people to take advantage of the best of educational infrastructure.

In addition, people everywhere can find themselves effectively isolated from the conventional educational system, by virtue of age, gender, cultural factors and economic circumstances. By way of illustration, it is not hard to visualize the difficulty older persons might experience when faced with the need to retrain, should this require them to attend classes filled with much younger students. Yet, today's pace of rapid technological change is increasingly requiring such people to up-date their skills or face obsolescence and unemployment.

Foreward thinking educators around the world have long sought to provide a more universal and equitable access to education, regardless of the state of individual development or physical location, through the interrelated concepts of open learning and distance teaching. There are numerous examples of the application of these techniques ranging from Memorial University on Canada's North Atlantic Coast to the University of the South Pacific.

These modalities of education depend upon delivering educational materials, either by mail or electronically, to students in their homes, work places or nearby study centres, where they teach themselves and receive help from visiting tutors or remotely by telecommunications. The more fortunate of these students have their learning experience enhanced with additional related materials received through educational broadcasting or by means of video and audio tapes which can be replayed locally as often as is needed.

The dependence of distance education on telecommunication is manifold. Telecommunication facilities are needed for the administration of often widely scattered campuses. They are used occasionally for the remote delivery of course materials and lectures. An increasingly important aspect of telecommunications is as the means of communication between educators themselves, both within and between institutions. This is not only crucial in the development of distance education materials and techniques, but it is an essential element in building a sense of cohesiveness in the community of educators who are geographically dispersed.

The types of telecommunication facilities employed in distance education covers the spectrum of what is available, from HF radio to satellites. The modes of communications are equally diverse, including voice, video, facsimile and data. In North America, examples of broadcast educational television are numerous, whereas in other parts of the world voice facilities predominate. A few educators are leading the way to the future by experimenting with video teleconferencing and computer networking.

And yet, as societies' dependence upon distance education is growing, the development of this field is being compromised in many cases by inadequate access to suitable educational materials and by problems of telecommunications availability and cost. For these reasons, the Leaders of the Forty-nine countries that make up the Commonwealth decided in Vancouver in 1987 to take the dramatic step of establishing the Commonwealth of Learning, the organisation of which I have the privilege of being President.

The role of The Commonwealth of Learning is to promote and accelerate the development of human resources throughout the member states through improving distance education and through facilitating co-operation between distance education institutions. It was recognised that the shortage of education materials could largely be overcome if those materials individually existing in various parts of the Commonwealth, could be assembled together in a vast reservoir and made available to all. Therefore, the founding instruments of The Commonwealth of Learning call for the development of a data base of educational materials and expertise. Access to the data base will of course depend on the availability of suitable telecommunications. Other responsibilities of The Commonwealth of Learning include strengthening the training of educators and fostering exchanges and intercommunications throughout the distance education community, all involving further reliance on telecommunications.

Although The Commonwealth of Learning is a new organisation, I am pleased to tell you that our basic structure is now in place and functioning. We have gathered together senior distance education expertise from around the World. Professor G. Ram Reddy, formerly Vice-Chancellor of the Indira Gandhi National Open University of India, has joined us as Vice President, with special responsibilities for Asia. We have Dr. Dennis H. Irvine, former Vice-Chancellor of the University of Guyana as Director of Caribbean Programmes and Mr. J. Peter McMechan, previously Director of University Extension of the University of Otago in New Zealand, as Director of our Pacific Programme. Alhaji Hafiz Wali, of the National Teachers Institute in Nigeria has just joined us as Director of African Programmes and, I have with me here today, Mr. John Quigley, formerly Director General of the Pacific Region of Canada's Department of Communications, who is our Director of Communications and Technology.

I am pleased to be able to tell you that we have already made substantial progress towards universal access to educational materials. We developed a pilot data base including some ten thousand courses and demonstrated the system at the recent Heads of Commonwealth Governments meeting in Kuala Lumpur. We are now working with The International Centre for Distance Learning at Milton Keynes to develop an operating data base which we hope to have ready for demonstration at the Meeting of Commonwealth Ministers of Education, to occur in Barbados in the fall of this year.

We expect this data base to be available to member institutions shortly thereafter to facilitate their development and access to educational materials suitable for distance education. Of course, the success of this data base rests in part on the practical availability of dependable and affordable tele-communications. I use the term "practical availability" advisedly, for we all know that there exists now between most countries of the world, high quality telecommunications through the good work of various organisations, such as INTELSAT which operates satellite systems, and others who have undersea cable networks. However, in too many instances, inadequate domestic telecommunications infrastructure makes access to the excellent international facilities difficult. In other cases, lack of resources and other vital priorities, do not allow available facilities to be used for educational purposes. As well, on occasion, educators find it difficult to express and define their telecommunication needs in a manner that would lead easily to the timely provisioning of necessary telecommunications service.

I must confess however that I am heartened by a few situations where all these problems were overcome, and distance education is being conducted over high quality telecommunication networks. One example is in the University of the South Pacific, of which I had the pleasure of being Vice-Chancellor, where there is today with the help of INTELSAT a distance education system based on satellite facilities operating between several island nations spread over thousands of miles of ocean. This success had its beginnings in the earlier help of the National Aeronautics and Space Administration of the United States, which made satellite capacity available on ATS 1, and facilitated the start up of the University of the South Pacific's distance education System. Other successful distance education telecommunication systems exist in many parts of North America, Europe and Asia.

However, these successes pale in significance when one looks at the overall telecommunication needs of educators on a world scale, and how these needs will evolve in the future. Isn't it a paradox when the Telecommunication Industry has found ways of harnessing technology to provide instant, high quality voice, video and data communications between countries and to ships at sea, that most educators must communicate with their students through the mail, and often travel considerable distances to provide tutoring support. In many parts of the world, the only communication system available for distance education is high frequency radio, while in other locations, it is common place to deliver thirty or more television signals into livingrooms.

One of the greatest challenges The Commonwealth of Learning faces is to help educators define their needs for and obtain access to appropriate and affordable telecommunication networks and hardware. We have made a start, by asking the help of Professor Bill Melody's new Centre for International Research on Communications and Information Technologies, based in Melbourne, to assist with the definition of strategies and options which might show the way ahead. We feel that a key element will be encouraging and finding the means by which educators can cooperate together in determining and packaging their telecommunication needs, to take maximum advantage of the limited resource available and to facilitate the provision of common systems. More than ever, educators need the help of the telecommunication industry, and I invite you all to provide your advice and assistance in helping The Commonwealth of Learning in this worthy and necessary endeavour. By making more affordable telecommunications systems available to distance education, we can contribute to the goal of allowing people everywhere equitable access to education, and thus help them have a more productive life.

Session 1.1

Country Overview I

NOTES

Telecommunications and Its Prospects in China

Zhen KaiYuan
Professor
Southeast University - Nanjing
P.R. China

ABSTRACT

This paper deals with the development of many means of telecommunications in China. These will be rapidly developed in the near future. Also, the research project of our university is introduced.

General Introduction

China, with a time-honoured history of over 5,000 years and a vast land of 9,600,000 square kilometers, differs remarkably in geography and climate. In general, the land is even in the southeast while hilly in the northwest, with a population of 1.1 billion and over 50 nationalities, which the Han nationality is 93%. Each nationality has its own language, the Han nationality has many regional dialects as a result of different living areas. With the unequal density of the population, about 90% of the total population live on 40% of land area. The density of population in the Long River delta indicates 350 people per square kilometer, a good match for the Netherlands, which has the densest population. The economy, culture, traffic and transportation in this area rare far more advanced than the western region and far away mountainous area.

The telecommunications in China, though still backward, are developing rapidly. Before 1949, the year when the People's Republic of China was founded, the Chinese telecommunications were very backward, and lack of equipment, for example: slow delivery of letters, few telephones, less possibility of private telephones (some of which were magnetic and turned by hand, got through not by dial but by the operator. Long distance calling was more difficult and it took a long time to wait, even not get through in the end...) The telecommunications at that time, at most, at the primary stage.

During the 40 years afterwards, the telecommunications in China have seen rapid development, especially in recent 10 years of the reform and open policies. We realized that telecommunications are an important component of social productivity, the fundamental aspect in the national economy and a necessary condition for social development. This basic point of view has been accepted by more and more people. Especially with the development of planned commodity economy and export-type economy along coastal areas, the importance of telecommunications is being more and more deeply sensed. It is getting very significant for the construction, production, education, scientific research and even daily life in China. Therefore, telecommunications are in rapid demand. In recent 10 years, the provinces of Guangdong and Fujian, and the cities of Beijing, Tianjin and Shanghai, together with other provinces and cities in the coastal areas have designated a rising rate over the average level in China, a fact which can serve as apparent evidence.

The author's forecast of the last two years' statistical data will offer a rough description of the telecommunications development in China (The sub-items of the development statistics go as follows)

In 1988, the central task of telecommunications in China was to strengthen and better the capacity for telecommunications, and to promote the unity between social benefit and enterprise benefit. The post and telecommunications division completed an investment of 2 billion Yuan (R.M.B.) of fixed assets the whole year and the post and telecommunications business reached 5.4 billion Yuan, increasing by 26.3% over last year. The year 1988 enjoyed the largest rate of historical increase. The upper half year saw the completion of 3.06 billion Yuan, accounting for 51.1% of the total revenue of post and telecommunications, increasing by 24.1% over the same time last year. The revenue of post and telecommunications business completed 4.2 billion Yuan, 50.63% of the annual schedule. Up to 1990, the major target of the total post and telecommunications in supply for the society will amount to 7 billion Yuan. Post and telecommunications research, industrial production, specialized training and technical renovation in enterprises will be strengthened. Program control exchange, photofibre communications, satellite communications, digital microwave and other equipment will be produced at home. Of course, we are still meeting with a lot of difficulties, such as serious lack of telecommunications capacities and sharp contradiction of demand and supply. Post and telecommunications are still an important factor which restricts the development of national economy and influences open policies to foreign countries. We will strive to overcome difficulties ahead of us.

Post Service

China had an early development in post service. Since the people's average income is quite low, post cost is also quite low: a letter inside a city costs 0.04 Yuan, outside 0.08 Yuan, par avion 0.1 Yuan. The prices have ever remained many years until now. Only international post has moved a little up to 1.6 Yuan for one letter.

In 1988, the total completion of post business was 31.58 billion pieces, a 14.3% increase over 1987, among which overseas and international super express were 477,000 pieces, 795,000 pieces at home and express 57,500,000 pieces. In 1988, international super express opened to 56 countries and regions, a 50% increase of delivery. 172 cities in China has established domestic super express service with an increase of delivery over two times. 1960 post offices have opened up express service. The revenue of stamp collecting service amounted to 0.18 billion Yuan, an increase of 28.5% over the year before.

In the upper six months in 1989, only express post increased 15.3 times over the same period last year, and super express 72.6%.

Pursuing the post coding system is a significant reform, which once started in 1980, but failed because of insufficiency in conditions. In 1987, a propaganda month was made again, 268 large and middle cities joined in the movement, accounting for 97.2% of the whole cities. According to the post and telecommunications ministry, official affairs must conform to post coding. Now the post coding system is being popularized throughout the country.

Telephone Business

Telephone communications is one of the largest network over the world, an indispensable component.

Telephones in China are still below the demand, though they are developing rapidly. Statistics of the recent years show: until the end of 1987, the total capacity for urban exchanges number 4,645,000 and rural exchanges 3,094,000; a totality of 7,739,000; urban telephones 6,283,000, while rural telephones 1,774,000; totalling 8,057,000. One hundred people to 0.75 telephone. Yet, the velocity of development is over the average level in the world. For instance, the telephone master sets gained a rate of increase of 9.5% in 1986, twice faster than the average rate of the world. In 1987, the capacity for urban exchanges increased by 22.1% and urban telephones by 15.5%.

In 1988, urban exchanges increased 849,000; long-distance auto-exchanges 28,000; long-distance telephone circuits 14,700; cable 1305 km and micro-wave 3243 km. The first six months in 1989 saw a completion of urban telephone users 386,000; users with a right to direct dial for long distance 150,000; urban exchanges 350,000; long-distance circuits 6,700; and long-distance auto-exchanges 14,000 ends. According to the annual plan for 1989, there will have newly established telephones 800,000 and 600,000 put to use; long-distance auto-exchanges 30,000 and 20,000 put to use, with 12,000 new business circuits.

The coastal provinces and cities are more remarkable. The total capacity for urban and rural telephones in Guangdong province were only 90,000 ten years ago, but now it has 1,000,000 being the first province over 1,000,000 in China, accounting for 1/8 of the total national capacity. In 1990, the plans to put forward telephone network construction, to distribute numbers for 1,500,000 users within two years, making the total national telephones up to 13,500,000 (containing exchange telephones and rural telephones) and increasing 32,000 long-distance circuits, making the total national long-distance circuits up to 100,000 lines. Up to 1990, 40% of nationwide long-distance users can dial directly. Furthermore, to develop direct dial, so that you can make an international direct dial in coastal opening regions, hotels, airports, harbours and stations of large cities. From above, it is easy to find that the basis in China is unstable, but the potentiality is quite large. It is estimated that up to the year 2000, the total number of telephones in China will amount to 33,000,000, among which urban telephones will be 12,000,000; exchanges 11,600,000; rural areas 10,000,000, with a popularity rate of 2.8% in the whole country, 10% in large cities, 5% in the middle cities and counties. But the rate will be higher along the coastal regions, for instance, there will be one telephone for four persons in Shanghai.

Telex

With ten years of development in telex, there have been over 10,000 users distributed in 85 cities throughout the country. Its development is affected by fax, so not popular. Though it's lower in expenses, telex fails to use Chinese characters and relay original pictures, so it's not convenient. Of course, it still owns superiority in other means of telecommunications and information index for teaching and researching ends. Mostly, it appears in government, institutes, commercial, departments, banks, telecommunications bureaus, hotels and important teaching and researching departments.

Fax

The development of fax in China began by the end of 1950's and cloud-graph fax began to be made at the beginning of 1970's. At that time homemade document fax mainly first-type, second-type, climate-fax and analogue-type photo fax.

At the beginning of 1986, the third-type fax was introduced as a modernized manufacture. But, the colour photo fax with digital store was just at its first step.

The current situation in China can be generalized as follows: photo fax, with two thirds homemade, is used in Security Bureau and newspapers. Fax for climate is 100% homemade. The first and second type document fax is all homemade. But they are being replaced gradually by third-type devices since 1984. In the last two years, the third-type device has been a rapid development, mainly used in party and administrative institutes, army, energy, commercial, transportation, foreign venture and industrial and commercial enterprises, banks, large factories, mines and scientific research. It is estimated that up to the year 2000, there will be 500,000 faxes.

Broadcast Satellite Telecommunications

China launched her first man-made satellite on April 24, 1970, and over twenty others including a few earth synchronized telecommunications satellites in step. The first experimental telecommunications satellite DFH-2 was launched on April 8, 1984; the second functional broadcast telecommunications satellite DFH-2 was launched on February 1, 1986, and the third one, DFH-2A was launched on March 7, 1988 -- to solve the problem of watching TV and telecommunications in remote and mountainous regions. Another one was launched on December 26, 1988.

As mentioned, China is a vast and populous country with unbalanced development and means of transportation. The telecommunications, television and broadcast are terribly difficult in the west and remote mountainous areas. Cultural development is in the same boat. TV education, data conveyance, TV meetings and TV therapy are important means for the Chinese people's education and health. For this reason it is very urgent to better the means of telecommunications. On October 1, 1986, the educational TV program from the satellite opened up, making it possible for anyone, anywhere in China, to tune in to the program. Because of the geography in China, TV broadcast hardly covered the whole country; only 30% of the total population. When the satellite telecommunications run overhead, things have changed greatly.

Up to the end of 1988, satellite communications in China are proceeding as follows:

TV program, beginning from 1985 by satellite, is so far, nationwide, and used also in post and telecommunications and climate data telecommunications. Except for telephone and telegram, there are also newspaper fax between Beijing and Urumqi by the satellite services, which will further develop in the future.

In 1989, the enlarged project on five earth stations for satellites in Beijing will be opened up, and a number of new stations will be set up in important cities for communications between large regions and between provincial centers and large regional centers.

It is predicted that until the end of 1992 China will launch the functional large capacity telecommunications satellite "Dong Fang Hong2", and meanwhile, six ways of color TV and 15,000 ways of telephones or telegrams, fax and so on.

Photofibre Telecommunications

The development of photofibre telecommunications in China started from the beginning of the 1970s. In 1978, the first digital photofibre outdoors experimental route opened. In 1979, Beijing and Shanghai put photofibre telecommunications into public network relays. According to rough statistics, up to September 1988 China set up ten long-distance photofibre routes for public network, about 1100 km in length, covering about 40 cities, whose photo-fibre routes total 2000 km. In addition, it is also used in railway, electrical telecommunications, radio stations, TV station, enterprises and mines, traffic hubs, colleges and universities, research institutes, hospitals with a total length of 2000 km. As a whole, there has been over 5000 km throughout the country. Up to June 1989, there have been 151 lines totaling 12,000 km in public and special network including those established, being established and to be established that are covering 26 provinces and cities except a few remote provinces. To 1990, photofibre telecommunications systematic capacity will be enhanced to an annual production of 50,000 to 60,000 km. It is estimated that up to the year 2000, an annual production of 300,000 km.

Photofibre telecommunications are closely concerned with the permanent construction for domestic network of telecommunications. It will meet the needs of sharply rising business for digital telecommunications. However, it cannot be put in full spring at present and mainly exported, but on the basis of domestic production. So, at the present stage we are better to develop microwave telecommunications, especially digital microwave as a transition.

Mobile Telecommunications

Mobile telecommunications is not popular in China. Mostly seen is in taxis in large cities having a few years of history. Others are rare. In the last several years with the development in reform and open policy, wireless search call (BB call in China) has appeared and is speeding up. According to statistics, there were 70 cities which had put up wireless search call, with 90,000 users in 1988.

Mobile telephones are meeting with more welcome in Guangzhou, Shanghai, Beijing and other cities but are not overly popular. According to a survey, up to May 1988, mobile telephone users were only 1000. But in May and June 1989, B call in Guangzhou reached over 30,000 with a totality of about 167,000 users nationwide, and is still developing.

The Research Project of Our University

We are in Charge of the project "Jiangsu Nanjing City Computer Network Development Plan". Jiangsu Science and Technology Commission has decided to invest in developing Jiangsu Computer Network (JSnet). The first phase of the project is to build up Nanjing city area computer network within the next five years. This phase of the project, undertaken by our university and other units, will be completed by 1991. In 1992, the second phase of the project will be performed, with the purpose of consummating the functions of the network and extending the network geographically to the other cities in Jiangsu province.

The objectives of the project phase one are:
(1) Build up an extendable, experimental heterogeneous computer network with 3-5 nodes.
(2) The connection between each node within JSnet is in the way that conforms to ISO-Open System Inter-connection (OSI/RM) and protocol's standards.
(3) Provide some information transferring and processing services such as information retrieval and videotex etc. to the users in Nanjing city area.

JSnet development subjects are:
(1) Research and implementation of OSI reference model and protocol conforming to ISO/OSI protocol standards is the main characteristic of JSnet.
(2) Development of communication processor (CP) for communication subnet. CP in communication subnet is asked to have some switching and network management abilities. X.25 standard is used for subnet interface so as to connect with public data network conveniently. CP provides to connect with hosts. In order to shorten the developing time, microcomputer having X.25 communication board with total three level procedure software is desirable.
(3) Research on network management: Independent network control center (NCC) still needs to be researched and developed for the future extension.
(4) User network access device development. There are three types of user network access devices: terminals of the hosts within the user-resource subnet; packet assembling and disassembling device (PAD); and microcomputers.
(5) Heterogeneous computers interconnection: For microcomputers to access the network, only the OSI 4-7 layer software need to be implemented for it. The lower three layers can be supported by X.25 CCU. The higher four layers functions can be minimized to reduce the system overhead of the microcomputers.
(6) LANs interconnection and LAN and mainframe interconnection.
(7) Research on Network data security.
(8) Supporting to some information systems and information services: supporting to some practical information systems such as project's management, science and technology information retrieval and library retrieval, as well as tax management and also developing Videotex services.

Development strategy: communication protocols implementation will conform to the current ISO/OSI standards. Native and abroad, existing techniques should be fully utilized for the network implementation. And international cooperations are warmly welcome. It is also desirable to import advanced techniques and devices from abroad for every possibility.

The items above give a detailed description in telecommunications. As to my university, it is easy to find change in telecommunications in the past several years. My university was once called Central University, being quite well-known and boasting of a history of over 80 years. At present, it is one of the key universities in China, with about 10,000 students and several thousand teachers and staff. It is super in scale and level. Respectively speaking, we have better telecommunications equipment, with direct telephone, telex and fax. More and more advanced means of telecommunications are being used. Though telephones have developed fast, they are still unable to meet the requirements of our university, as compared with the current number. Not anyone has telephone at home, it only accounts for a small ratio in such a large university as ours.

Our open policy and reform are interchangeable, and communications at home and abroad are getting more and more frequent. Officially, people to people, industrially, economically, commercially, scientifically, culturally, educationally and many others. All this is sure to raise higher demand upon telecommunications. Telecommunications are essential to save manpower, material, time, money and to raise efficiency. Many foreigners say to me" "Cars and telephones are not developed in China, a far cry from abroad. Yet, China doesn't have to develop cars, especially private cars, but must develop telephones. They are beneficial."

I basically agree with this viewpoint. As a professor, I am engaged in a lot of work in teaching and research, technical service for society, communicating at home and abroad as general manager concurrently. It was inconvenient before the installation of telephone at home. Now I not only have domestic direct telephone but also a divided telephone at home, which largely enhances my work efficiency and social and economic benefits. I was the first to telex and fax at the University, which plays a very important role in my communications with foreign countries. These ten years I've visited Europe and America many times, to inspect, teach, attend meetings, and make a tour. On the occasions of emergency, telecommunications solved difficulties for me. So, further development of telecommunications is a must. Recently, an international telecommunications organization sent me a questionnaire in telecommunications, which raised my strong interest in the field. The U.S. "dcr" magazine (that I visited in 1983) introduced PTC to me, so that I had the opportunity for exchanging ideas. I feel greatly honored for this.

THE TELEPHONE IN HONG KONG SOCIETY

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Hong Kong's telecommunications have simple tariff structure and generally low charges. This has had a favourable influence on attitudes to telecommunication services, which has assisted developments in the industry. The changing regulatory environment will also continue to influence the industry in the next decade.

INTRODUCTION

The dependence of economic growth on a good telecommunication service is well recognised. However, the impact of the ownership of the telecommunication service, the regulatory regime and approach to pricing can have a major impact on the view society takes of its telecommunication service.

Hong Kong presents an interesting case study, both because of the development of the telecommunication services todate and the fact that we stand on the threshold of a new regulatory and business environment for the future.

Hong Kong Telephone Co. has always been a private sector company since its formation in 1925. It has enjoyed an exclusive franchise to provide telephone service within Hong Kong, and to interconnect with Cable & Wireless (Hong Kong) Ltd. which has the exclusive right to offer international telecommunication services from Hong Kong.

Hong Kong Government policy generally is for minimum interference in business. Almost all public utilities in Hong Kong are operated by private sector companies. Hong Kong Government exercises necessary public control over utilities via a series of regulatory licences and ordinances for each of the private sector companies operating a utility service.

It is becoming increasingly accepted that private sector ownership of essential services confers many benefits over public sector ownership. Public sector corporations tend to be subject to a wide range of Government policies, and to be made an instrument of those policies. Thus, Government owned telecommunication corporations often have imposed on them policies relating to purchase of plant and equipment, employment policies, national development and financial constraints. On the other hand, private sector corporations are essentially motivated by the need to reward investors and shareholders. This motivates the business to expand and grow. It generates good marketing practices and concern for the consumer in order to achieve business growth objectives. It is not constrained by Government policies other than those directly applicable to national telecommunications requirements.

Hong Kong Telephone operates under a scheme of control which places an upper limit on the return on shareholders funds available to the Company. A shortfall in the level of return triggers approval for tariff increases. As well as demonstrating that a tariff increase is necessary to achieve the permitted return, the Company must also demonstrate productivity and efficient operation before a tariff increase will be approved.

A FLAT RATE TARIFF

Historically, the Hong Kong Telephone network has developed under a flat-rate tariff regime. There are no call charges within the territory of Hong Kong, but customers pay a monthly rental charge, currently HK$47 (US$6) per month for residential service, and HK$70 (US$9) for a business service. The flat-rate tariff encourages high calling rates. High per line calling rates are usual in developing countries where the penetration level of the telephone service is low, but unusual in a location like Hong Kong which has close to 100% of residences and businesses connected to the telephone service.

The fact that internal calls are free has an interesting impact on people's social habits. There is never any difficulty about using someone else's telephone, and people rarely ask for permission but take it for granted. Shops and even hawker stands will often provide a courtesy phone for use of customers; in some cases restaurants will locate a phone in the street outside their doorway to attract passers-by. Consequently the number of public payphones is relatively low compared to many countries. The incidence of vandalism of payphones and courtesy phones is very low.

Another interesting impact is that there is no inhibition on children using the phone from an early age, and dialling habits tend to be undisciplined. This results in a high incidence of wrong numbers, which has been aggravated by the fact that, until the end of 1989, Hong Kong had three separate numbering areas with specific access codes for each area. The situation has improved with the introduction of a unified numbering scheme from 30 December 1989.

The universal availability of the telephone service coupled with childhood habits of using the phone freely makes Hong Kong a perfect market to sell value added telecommunication services, a factor happily exploited by Hong Kong Telephone and other vendors.

From time to time Hong Kong Telephone has considered the merits of introducing call charges. However, under the existing scheme of control there would be no financial advantage to the bottom line, and the network, having been dimensioned for high calling rates, will not obtain significant cost advantage from a lower usage rate. Thus there is no financial incentive to introduce call charges for the basic telephone service. International and value added services are a different matter.

Hong Kong Telephone also appreciates the fact that a simple tariff structure is a great help in promoting customer relations. There is rarely a complaint about billing, due to the flat rate tariff for basic service. Where call charges do apply, such as international calls, detailed statements are presented to the customer. The fact that the basic tariff structure is uncomplicated and predictable, and the fact that our service standards are high, results in Hong Kong Telephone regularly being voted the most successful utility in Hong Kong.

The Scheme of control, being based on return over shareholders funds, motivates the Company to build shareholders funds. This in turn encourages the funding of investment from internal funds rather than debt, and the Company is encouraged to invest in new technology.

BUSINESS GROWTH

The natural wish of a private sector company to grow its business and profitability finds outlet in two directions: through growth of the basic services and through development of new telecommunication services.

During the 1970s, Hong Kong's economy grew rapidly and demand for telephone service expanded as well. In the early 1970s the Company was able to eliminate its waiting list for services and resolved never to allow a waiting list to develop again. We adopted the policy of providing service on demand. While this imposes a severe discipline on the planning of the network and tho availability of staff and equipment to meet service requirements, it is a clear guiding rule which motivates all areas of the Company. This policy, coupled with low prices which places telephone service within the reach of everyone, has been instrumental in making the telephone service a basic necessity of Hong Kong life. This in turn leads to quite simple planning rules - every new dwelling will require at least one telephone service as soon as it is occupied. Efficiency of plant utilisation follows.

The Telephone Company has also recognised that to stay successful in telecommunications, we have to keep our network modern. Successive systems have been introduced in switching and transmission, from Strowger through ESK and 10C to digital. We introduced digital transmission systems in 1967 and optical fibre in 1981. At present, 98% of transmission and 57% of switching is digital. We are currently replacing all analogue switching and transmission systems so that the network will be fully digital in 1993. We also keep pressure on our switch suppliers to upgrade the features available through new hardware and software releases. For example, we are currently including centrex capability in all our digital exchanges.

Having established virtually 100% penetration of the basic service, the business strategy has been to exploit the propensity of Hong Kong people to use the phone and use the capability of modern systems to introduce new services, to generate revenue growth. International direct dialling has been the most spectacularly successful of these, inspired by Hong Kong's international trading role plus the high incidence of Hong Kong families having friends and relatives abroad. Last year Hong Kong made 98.6 million overseas calls, 18 per person. Residential IDD calls account for 40% of total IDD calls, which is high relative to most countries. A range of business services for data and facsimile communications has been introduced to generate further growth.

The introduction of mobile communication services such as paging and mobile radio telephone has been very successful in Hong Kong. There are 650,000 paging units in use and 83,000 mobile telephone in use in a population of 5.6 million. The propensity of Hong Kong people to telephone is a contributing factor to these high levels of utilisation.

The use of a flat rate tariff for local telephone service produced some initial resistance to acceptance of new services carrying a usage rate charge. Until 1985 the penetration of IDD was low, and largely confined to business customers. However, the introduction of digital exchanges with IDD as a "standard" feature, and an optional service of "IDD Security" which only allows IDD access on dialing a personal 3-digit code, has overcome this resistance. We are also increasing the number of private and public payphones, with emphasis on stored-value and credit card phones to give IDD access.

Early customers of Datapak, our packet switching service, were concerned at the prospect of "unpredictable" usage charges, so we introduced an upper limit monthly usage charge as part of the tariff structure, and this quickly overcame customers' concern. There has been no resistance to the usage charges associated with mobile radio telephone service. The absence of local call charges has made provision of voice information services unattractive, although we are about to introduce our Infoline service, which provides for detailed billing of calls made to a range of information services. It is our Company policy to retain a flat rate tariff for basic local telephone service, for marketing and customer relations reasons.

A SECOND NETWORK

In 1984, the Telephone Company saw an opportunity to increase utilisation of its network through the introduction of cable television. This precipitated a debate in Hong Kong on future telecommunications policy, it being recognised that if the Telephone Company provided a cable television network, it would extend its control of the telecommunications network infrastructure. In July 1988, the Government decided to prohibit the use of the Telephone Company network for cable television distribution, with the specific objective of encouraging the construction of a second network. The Government also declared that the second network would be licensed to carry non-exclusive telecommunication services - that is, everything except telephone and telex service. The CTV franchisee was selected in August 1989, and the second network will commence construction soon.

The advent of a second local network will open possibilities for more local telecommunications competition. However, the international carrier has a franchise to the year 2006. Competing local carriers with a single long distance carrier is unique, and presents some interesting regulatory problems. Even if the Telephone Company's exclusive franchise on telephone service is extended beyond 1995, the digital nature of telecommunications technology makes it impracticable to enforce regulations which distinguish between voice services and data services.

Another issue is the conditions for interconnection between two local networks. In other countries having interconnection between competing networks, there are established call or duration charges, a portion of which can be assigned to the various networks involved in interconnection. In Hong Kong, where there is no local call charge, interconnect usage charges which are passed on to the end user are likely to create considerable market resistance. It remains for the operators to develop reasonable commercial interconnection arrangements which do not initiate the application of local call charges in Hong Kong.

Hong Kong Telephone regards the prospect of competition as an opportunity rather than a threat. We have already developed a policy of co-operating with other elements of the telecommunications industry, to develop the total business for the benefit of all. One example is our Faxline service. We have always registered facsimile machines connected to the telephone network, and therefore recognised the strong growth in facsimile as it took place. We designed a service specific to facsimile users which we called Faxline. Faxline offered, for a small additional monthly charge, support features which include a printed and on-line directory service, an on-line diagnostic facility, manual support for international calling, and a range of value-added fax services. We co-operated with the facsimile machine retailers, convincing them of the value of selling Faxline along with the facsimile machine. As a result, we know exactly how many fax machines are being sold and can share that information with the retailers, enabling them to work out their individual market shares. We also supply them with sales kits to help them sell faxline service at the same time as they sell a fax machine. We believe it is in part due to this action which has given Hong Kong one of the highest penetration rates of fax machines per capita in the world, with 86,000 fax machines in use.

Another example of industry co-operation is Citinet. We introduced our centrex service, called Citinet, at the end of 1988. This is in direct competition with keyline and PABX suppliers, but we have made Citinet available to companies who supply PABX and keylines, as an additional product to sell to their customers. They are given a discount on the end-user line charge, and also allowed to represent the service as their own, including provision of customer premises equipment, the management of moves and changes, and billing. This avoids the need for HKT to establish a large new sales force competing with companies with much more experience in this area than we have, and establishes an interest by the industry in the Citinet service.

With respect to a second network operator, we intend to apply the same philosophy. We believe the second network operator has the potential to become a major customer of Hong Kong Telephone, and we are prepared to offer service to him to achieve that. This should be beneficial to us, the second network operator, and the community, while not in any way depriving the community of the benefits of a competitive environment.

DEREGULATION

Telecommunications in Hong Kong is largely deregulated. With the exception of local telephone and telex, and international telecommunications, all services and equipment supply is competitive. There are many vendors of customer premises equipment who sell or rent, install and maintain their equipment. In fact, Hong Kong Telephone is prohibited from supplying CPE except to rent a basic telephone. There are 17 suppliers of paging service, 3 mobile radio telephone network operators, 2 operators of trunked radio systems for voice and/or data, and 37 licences issued to provide value added services (called Public Non-Exclusive Telecommunications Services) such as E-mail, voice mail, and store and forward facsimile.

The deregulated nature of telecommunications in Hong Kong has a number of side effects. There is a growing inter-dependence between customer equipment and the network to allow exploitation of new network service opportunities.

DTMF signalling is required to make full use of existing network service capability, and in the future C7 signalling will be desirable. However, Hong Kong Telephone has no direct control over the retailer of customer equipment. We must persuade him to sell DTMF rather than decadic equipment, and have initiated a programme of education persuasion aimed at both customers and retailers to achieve this. It will, however, be many years before we can hope to achieve 100% DTMF signalling.

Similarly, control of connection of equipment to the network presents problems. In a deregulated environment it is usual for the regulator to take over the "permit to connect" function from the telephone company, and this is the stated intention in Hong Kong. However, it is increasingly difficult for any third party to be able to evaluate equipment connections involving C7 signalling, ISDN, data switching protocols, or Intelligent Network protocols. These can only be checked by actually connecting to the network. On the other hand, simple equipment hardly needs permission-to-connect in a digital environment where transmission levels are not so critical, and for which a reasonable level of customer understanding can be expected.

For these reasons, Hong Kong Telephone has decided that it will not insist on permission-to-connect as a pre-condition of connection to the network. We will continue to offer a testing service for a fee, to evaluate customer equipment against our specifications. I expect this will be used for more complex equipment, and to give a selling advantage by more reputable retailers of telephones and attachments. We will protect our network by reserving the right to disconnect service if equipment causes danger to staff or problems to other users.

CONCLUSION

Hong Kong Telephone is approaching the new environment with the continuing motivation to grow our business and our profits. We believe the deregulated environment, including a second network operator, presents a business opportunity which can be exploited to our benefit, to the benefit of Hong Kong, and also to the benefit of other telecommunications industry operators. Value added service providers and the second network operator will be able to buy services from us on which to build their businesses, in a way which expands the total telecommunication business in Hong Kong.

Hong Kong thrives on free enterprise. The most significant "natural" monopoly is in the process of being broken. Telecommunications will expand successfully in a manner typical of Hong Kong business enterprises, retaining Hong Kong's pre-eminent position as a telecommunications hub in the Asia Pacific region.

Session 1.2

Marketplace Issues

NOTES

Technological Change, Obsolescence and Depreciation in Telecommunication Services Under Differing Regulatory Regimes

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ABSTRACT

This paper describes an empirical method for determining the depreciation of capital equipment used in the provision of telecommunications services, with adjustment for changes in the prices of labor and other variable inputs, the level and mix of services provided on the network, and the other types of equipment in use. Obsolescence due to rapid technological change will be captured in the depreciation measure, which can be used to evaluate capital recovery allowed under depreciation schedules of regulatory bodies and tax authorities.

I. INTRODUCTION

This paper formulates the measurement of the depreciation of telecommunications equipment in empirical terms, based on the value of the equipment in the provision of telecommunications services. The resulting model and depreciation measures can be used to assess the differences between economic depreciation and various rule-based depreciation schedules, under different regulatory regimes: rate of return regulation and price cap regulation.

The argument proceeds as follows.

a. The shadow cost of different types of telecommunications equipment can be determined by estimation of a restricted variable cost function. The shadow cost quantifies the economic value of the fixed capital input in production, and changes in this economic value through time may be used with other information to measure depreciation and obsolescence.

b. This shadow cost varies differently through time for different types of equipment, and takes into account the contemporary use of other equipment, the costs of labor and other variable inputs, and the traffic load and mix on the system.

c. Technological change may be represented by introduction of measures describing the performance characteristics of different vintages of equipment of a common type. For example, performance characteristics of a switch include the number of lines, the number of calls that can be handled simultaneously, the time required to complete a call-switching operation, the power requirements and heat dissipation of the switch, the reliability of the switch, etc. Technological change is then represented as changing performance characteristics, measured by technology indicators.

d. These technology indicators can be used to explain the difference in shadow cost between different types of switches, as well as the changing requirements for other inputs such as operators, and maintenance and supervisory personnel.

e. Depreciation patterns imposed by the regulatory authority may differ from depreciation, and can thus distort capital recovery and the pace of technological change. These effects can be simulated with the estimated cost function model.

f. Finally, the effects of different regulatory regimes -- rate-of-return and price cap regulation -- on capital recovery and technological change can be simulated by using the estimated model.

For expository purposes, this model is formulated for switching equipment. However, the technique could be applied for other capital goods.

II. THE VARIABLE COST FUNCTION MODEL TO EMPIRICALLY MEASURE DEPRECIATION

The restricted variable cost function (RVCF) for studying depreciation expresses the variable cost, VC, of an output quantity telecommunications services, Y, delivered on a network of size N, as a function of several variable labor inputs, X_i, and other purchased inputs, M (intermediate goods and services). There are two types of quasi-fixed capital inputs: switching equipment denoted S, and an aggregate of other capital inputs Z. Several types of switches with differing performance characteristics are recognized,

S_k, $k = 1,\ldots,K$

Thus the RVCF may be summarized

$$(1)\ VC = f(P_1,\ldots,P_M;Y,N;Z,S_1,\ldots,S_K)$$

A translog variable cost function is applied to approximate equation (1), as follows

$$\begin{aligned}(2)\ \ln VC = {} & a_0+\Sigma_i a_i \ln P_i + 1/2\ \Sigma_i\Sigma_j a_{ij} \ln P_i \ln P_j \\ & + \Sigma_m b_m \ln Y_m + 1/2\ \Sigma_m\Sigma_n b_{mn} \ln Y_m \ln Y_n \\ & + \Sigma_r c_r \ln Z_r + 1/2\ \Sigma_r\Sigma_s c_{rs} \ln Z_r \ln Z_s \\ & + \Sigma_i\Sigma_m a_{im} \ln P_i \ln Y_m + \Sigma_i\Sigma_r a_{ir} \ln P_i \ln Z_r \\ & + \Sigma_m\Sigma_r b_{mr} \ln Y_m \ln Z_r \quad \text{for } i,j=1,\ldots I \\ & \qquad m,n=1,\ldots,M \\ & \qquad r,s=1,\ldots,R\end{aligned}$$

Standard parameter restrictions for such a model are given in Norsworthy and Jang (1989a).

Total cost is the sum of VC and the cost of capital services:

$$(3)\quad TC = VC + \Sigma_r V_r Z_r$$

where V_r is the service price of capital input Z_r.

The service price of Z_r in time period t, V_{rt}, is formulated as in Norsworthy and Jang (1989a)(2), as adapted from Jorgenson, Gollop and Fraumeni (1987):

$$(4)\ V_{rt} = P_{rt}(R_t+D_{rt}+G_{rt})/u$$

where P_r is the asset price for Z_r

D_r is economic depreciation of Z_r

i.e. $G_{rt} = (P_{rt}-P_{rt-1})/P_{rt-1}$

u is an adjustment for tax effects(3).

It is conventional to estimate the model in terms of the RVCF, equation (2), and the equations for the shares of each input in the variable cost which are given by

$$\begin{aligned}(5)\ s_i = \delta \ln VC/\delta \ln P_i = {} & a_i + \Sigma_j a_{ij} \ln P_j \\ & + \Sigma_m a_{im} \ln Y_m + \Sigma_r a_{ir} \ln Z_r\end{aligned}$$

Technology is better represented in a model estimated in physical units, however.(4) Thus it is preferable to estimate the input demand equations jointly with the RVCF. The estimated input demand equations are given by

$$(6)\ q_i = (VC/P_i) \cdot s_i + e$$

where VC is the estimated value of VE from the equation

$$(7)\ VC = \exp(\cdot) + \Sigma_i p_i e_i$$

where $(\cdot)$ represents equation (2) above.

The model given in equations (6) and (7) can be estimated by the full information maximum likelihood (FIML) procedure. The next section shows how the parameters of the estimated models and variants thereof can be used to analyze depreciation issues in the context of regulatory constraints.

III. SHADOW COST (OR SHADOW PRICE) AND DEPRECIATION OF QUASIFIXED CAPITAL INPUTS

The shadow cost of quasifixed capital equipment -- that which is fixed in the short term -- is the saving in variable inputs that would result from one additional unit of the capital good. This concept is congruent to the shadow price concept in mathematical programming for inputs subject to binding constraints. When only one fixed input is present (or an aggregate of fixed inputs is constructed), then the shadow cost, SC, that input may be determined computationally (i.e., without estimation) as

$$(8)\ SC = (TR-VC)/QK$$

where TR is total revenue. However, when there are multiple fixed inputs, equation (8) gives only the average shadow cost of all inputs. A statistical model is required to apportion the short term return (TR-VC) among the multiple fixed inputs. For the translog RCVF, the shadow cost of a switch of type r, denoted Z_r, is given by

$$\frac{\delta CV}{\delta Z_r} = \frac{CV}{Z_r} \cdot \frac{\delta \ln CV}{\delta \ln Z_r} < 0 \quad (5)$$

Hence to express the shadow cost as a positive quantity for conventional interpretation,

$$\begin{aligned}(9)\ \delta CV/\delta Z_r = -CV/Z_r \cdot {} & (c_r+\Sigma_i c_{ir} \ln P_i \\ & + \Sigma_m b_{mr} \ln Y_m + \Sigma_s c_{rs} \ln Z_s)\end{aligned}$$

Equation (9) (and variants thereof) is the basis for the empirical analysis of depreciation of a particular capital good, Z_x. If the time dimension is ignored (provisionally), economic equilibrium, and economic depreciation that enables full recovery of the economic cost of capital, is characterized by the condition where the shadow cost of a switch of type r is equal to its long run equilibrium service price V_r.

(10) $\delta CV/\delta Z_r = V_r$

Σ which leads by substitution from equation (10) to the economic depreciation rate for switches of type r

(11) $D_r^* = \frac{\delta CV}{\delta Z_r} \cdot \frac{u}{P_r} - R - G_r$

where R* is the long run or alternative cost-based rate of return, and $\delta CV/\delta Z_r$ is the empirically determined shadow cost of switch r(6) when condition (10) holds.

A test for the sufficiency (regulatory or tax) of allowed depreciation rate D_r to just enable capital recovery is therefore

(12) $D_r = D_r^*$

For $D_r < D_r^*$, depreciation is not sufficient for capital recovery, given current prices for telecommunications services. For $D_r > D_r^*$, allowed depreciation exceeds economic depreciation.

IV. TIME-VARYING DEPRECIATION AND OBSOLESCENCE

In practice, the shadow cost of a particular telecommunications equipment will vary through time. Some of that variation is due to other explanatory elements in equation (11), rewritten below in expanded form.

(13) $D_r = -(c_r + \Sigma_i a_{ir} \ln P_i + \Sigma_m b_{mr} \ln Y_m$

$+\Sigma_s c_{rs} \ln Z_s) \cdot (u/P_r \cdot CV/Z_r)$

$- R - G_r$

Several elements of technological change affecting the economic value and hence economic depreciation of type r switches are capsized in equation (13). Clearly, for example, a rising (alternative cost-based) rate of return, R, or rising capital gains, G_r, would act to reduce the rate of depreciation required to recover capital investment, and vice versa. In addition, three types of obsolescence (or appreciation) can be identified. Obsolescence due to the introduction of other switches, for example, is measured by

(14) $\frac{\delta D_r}{\delta Z_s} = -c_{rs} \left|\frac{u \cdot CV}{P_r Z_r Z_s}\right|$

Of course, the other types switches are expected to be substitutes for type r switches, resulting in a negative value for the coefficient c_{rs}.

Obsolescence due to changes in the level of some output Y_m are measured by

(15) $\frac{\delta D_r}{\delta Y_m} = -b_{mr} \left|\frac{u \cdot CV}{P_r Z_r Y_m}\right|$

Obsolescence of type r switches due to changes in the prices of the variable inputs (labor and other purchased inputs or "materials") is simply

(16) $\frac{\delta D_r}{\delta P_i} = -a_{ir} \left|\frac{u \cdot CV}{P_r Z_r P_i}\right|$

In order to assess the contributions of various performance characteristics to technological change, the quantity of a particular type of switch is modified by a vector of performance characteristics or technology indicators as in Jang and Norsworthy (1989). The formulation here is shown for a single performance characteristic. This technique has been applied t the use of semiconductor devices in computers and in telecommunications equipment to capture unmeasured quality change.

Let q_r represent a technology indicator for switches of type r. Then the physical quantity of type r switches, Zr, is rewritten in performance units as

(17) $Z_r^* = Z_r \cdot q_r^{g_r}$

where g_r is a parameter to be estimated in the model. The same performance measure or technology indicator -- with different values -- is used for different switch types. Then in the estimated model, $\ln Z_r$ is replaced by

(18) $\ln Z_r^* = \ln Z_r + g \ln q_r$

If technology indicator has no effect that is not already incorporated in the quantity measure of the switch, the parameter g will have an estimated value near zero. However, if higher levels of q_r are associated with greater economic performance of type r switches then the parameter g will be nonzero.

For nonzero values of g, the effects on depreciation of technological change represented by higher levels of the index q_r can then be interpreted as obsolescence effects: the changes through time in the economic value of equipment resulting from the introduction of new equipment with better technological characteristics.

With incorporation of the technology indicator, the depreciation equation for Z_r is rewritten

$$(19)\ D_r = (c_r + \Sigma_i a_{ir} \ln P_i + \Sigma_m b_{mr} \ln Y_m + \Sigma_s c_{rs} (\ln Z_s + g(\ln q_s - \ln q_r)) \cdot (u/P_r \cdot CV/Z_r^*) - R - G_r$$

Obsolescence due to technological change then becomes

$$(20)\ \Sigma_s \frac{\delta D_r}{\delta(q_s/q_r)} = -\Sigma_s c_{rs} \cdot g \cdot \frac{(u \cdot CV)}{P_r Z^*_r (q_s/q_r)}$$

Equation (13) and (19) can be evaluated to determine economic depreciation based on the empirical implementation presented below, and the results compared with depreciation schedules permitted by regulatory and tax authorities. Shortfalls or excess in allowed capital recovery can then be identified.

V. REGULATORY EFFECTS ON DEPRECIATION

There are three regulatory states of current interest in the telecommunications industry: rate-of-return regulation, price cap regulation, and no regulation at all. These states are examined in turn in the light of the preceding discussion.

a. Rate-of-Return Regulation

Rate of return regulation of an integrated telecommunications company is expected to result in over-investment in capital goods according to the Averch-Johnson (1966), thesis. A non-integrated company as well as an integrated company will attempt to understate depreciation on its capital stock in order to raise the total return to capital.

Both the noneconomic substitution of capital for other inputs and the larger total return to capital resulting from inflation of the rate base will result in somewhat higher costs of service, and through the regulatory process, to higher charges to the customers.

In effect this results in a lower depreciation requirement, ceteris paribus, to recover the capital investment. Other measures of the depreciation/obsolescence response remain the same as outlined in section IV above. Clearly, the incentive for the regulated enterprise to seek lower depreciation to enable a higher total return is unchanged, if the enterprise is in a monopoly position. Deregulation of rates for telecommunications services with the introduction of competition subsequent to or coincident with rate of return regulation would lead to a discontinuous decline in the economic value of the capital stock, and a large discontinuity in empirically measured depreciation. The proposal write-down of AT&T's capital stock clearly has this character.

The response of the enterprise to more rapid depreciation from technological change under rate-of-return regulation differs from the unregulated enterprise in that the decrease of economic value of the stock will be compensated by even more investment. This practice will lead to costs of service that rise to the point that further gross capital costs cannot be recovered due to the elasticity of demand. At this point, the depreciation flow must exceed capital recovery, and decline in service quality will result, as well as poorly maintained capital stock.

b. Price Cap Regulation

Price cap regulation also operates through the rate of return in this formulation. That is, if the authorized price schedule results in an abnormally low rate of return, a higher depreciation rate will be required for recovery capital, as equations (11) and (13) show. If tax-allowed depreciation, or that permitted by state regulatory agencies, is below the rate required for capital recovery under a given price cap, then disinvestment the analysis here predicts that will result, particularly in the face of unregulated competition.

This problem is exacerbated when different state jurisdictions enforce different depreciation methods; a given price cap may lead to excessive capital recovery in some jurisdictions and deficient recovery in others. Under these circumstances, the likelihood is high that the quality of service will decline in jurisdictions where complete capital recovery is not permitted, resulting in substitution toward unregulated service suppliers by customers. Lower quality of service in some parts of the telecommunications network, of course, degrade the value of service to some degree on the rest of the network as well.(7)

c. Complete Deregulation

The basic formulation of this framework for analysis is appropriate to an unregulated environment. The competitive issues raised by declining marginal cost of telecommunications services in an unregulated environment are dealt with elsewhere in the literature -- extensively if not definitively. The most important issues arise concerning the transition of the industry from a regulated to an unregulated state. While a theoretical analysis such as outlined here can shed some light on these issues, they can be far better understood in the light of an empirical implementation such as described below.

VI. TOWARD EMPIRICAL MEASUREMENT OF DEPRECIATION AND OBSOLESCENCE WITH RAPID TECHNOLOGICAL CHANGE

Inevitably, the important issues concerning regulation are quantitative; theoretical models can seldom identify more than the directions of response to single events, where as regulation occurs in an environment where quantitative considerations dominate investment and other technology-related decisions.

The model outlined in this paper can be empirically implemented, based on several years' time series data for telecommunications companies. Such data are available from the FCC's common carrier statistics database, substantially supplemented by data from other sources concerning employment, wages, and prices of switches and other capital goods. Norsworthy and Jang (1989b) have demonstrated a model of the required scale for a cross-section of Management Sectional Centers for the U.S. Postal Service, which incorporated eight mail categories, three descriptors of the networks served, five labor and one "materials" variable inputs, and three quasifixed capital inputs.

Such a model can provide quantitative estimates of the shadow costs of different switch categories (e.g., analog, electronic, digital) and there depreciation characteristics through time, as technological change is incorporated into the national telecommunications network. Such a model can be a significant aid to rational regulation by all jurisdictions, especially as regards more appropriate depreciation policies to permit capital recovery under varying circumstances of regulation, technological change and domestic and international competition.

FOOTNOTES

(1)Show-Ling Jang is an economist at the Public Service Commission of the District of Columbia, and adjunct assistant professor of managerial policy and organization at RPI. J.R. Norsworthy is professor of economics and managerial policy and organization and a member of the Center for Science and Technology Policy of the School of Management. The opinions and conclusions expressed here are those of the authors alone and do not represent the Public Service Commission of the District of Columbia or the Pacific Telecommunications Council.

(2)Chapter 4, equation (1)

(3)Complete treatment of tax effects for a regulated enterprise would be more extensive and will be the subject of further investigation. A more complete treatment for the unregulated enterprise is shown in Norsworthy and Jang (1989).

(4)This argument developed in Norsworthy and Jang (1989b) based on the additive general error model propounded by McElroy (1987).

(5)The shadow cost is less than zero because variable inputs are saved; therefore $c_r < 0$ is required if switch has economic value in the sense of restraining output of the system.

(6)Equation (11) can be also used to impute depreciation to the various outputs.

(7)These same effects can be shown to result from differential property and income taxation across state jurisdictions when price caps are administered by a federal authority.

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Bringing Advanced Telecommunications Technology and Information Services to Remote Locations

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1. ABSTRACT

Telecommunications companies in many parts of the world are grappling with the need for widespread availability of advanced telecommunications services throughout their region or country by seeking low-cost alternatives for extending metropolitan-based services to remote locations. This document discusses some of the possible alternatives for extending voice and data communications (including ISDN), Mobile Communications, and Information Services to remote and less densely populated areas through the use of different networking architectures and transmission media.

2. INTRODUCTION

Advanced telecommunications technology and related services continue to be associated with the more highly populated areas of a region or country, where revenue potential can readily justify the cost of their deployment, operations support and maintenance. With the highly dynamic technological advances of recent years and aggressive new service deployment plans, the information gap between rural and urban communities has the potential to grow even larger.

The extension of advanced telecommunication services such as ISDN and mobile communications to rural areas is often cited as time intensive and very expensive. The physical plant is typically not in place to support these services, while revenues from that sector do not quickly recover costs of the necessary hardware, software, operations and maintenance. Over time, this situation has created a widening gap in the availability of newer telecommunications services between rural and urban areas.

In many cases, extension of telecommunication services by conventional means (i.e. using wireline facilities) is typically considered impractical or at least uneconomical due to factors such as cost-per-subscriber considerations, harsh or mountainous terrain, and right of way issues. To overcome these problems and reduce costs associated with the required long-haul transmission systems to scattered rural locations, network solutions based on wireless technology have been used in various configurations depending on the particular application, connectivity requirements, and the physical environment.

Wireless network solutions for extending telecommunications services to rural and remote locations can in general be grouped under two classes: those based solely on terrestrial installations, and those using satellite technology. The choice of one network technology over another is very much dependent on the application, and in some cases both technologies may be necessary to cover the particular range of basic and advanced telecommunications services to be offered.

Satellite communication systems, with their inherent advantage of being able to provide reliable point-to-point (or multi-point) service over large geographical areas at a distance-insensitive cost, generally offer very competitive network alternatives in applications involving many widely scattered rural communities, or where long distances are involved between the metropolitan hub and the rural areas to be served. Through the many domestic, regional and international satellite systems already deployed in the C-band (6/4 GHz) and Ku-band (14/12 GHz), virtually every remote location in the world can be reached via satellite.

Some specific applications and examples of vendor products available for extending basic and advanced telecommunications services via terrestrial and satellite networks are discussed in the following sections.

3. USE OF LAND-BASED NETWORKS

Microwave radio continues to be a very popular, reliable and cost effective wireless technology option for carrying voice, data and video traffic over long stretches of land or water. Because of antenna directivity requirements, microwave radio is used primarily in point-to-point applications, most commonly in medium or heavy routes, such as in the implementation of long-distance telecommunications networks. These systems operate in the frequency range from about 1 GHz to 40 GHz [1], and typically require the installation of repeater stations every 30 to 50 km. A local demultiplexing facility and distribution plant (cable or radio) is generally required to extend services from the link termination point to individual users.

Alternative land-based wireless network solutions exist that can extend services directly to the user. The most popular of these are rural radiotelephone systems and those which make use of small, stand-alone cellular switches.

3.1 Rural Radiotelephone Systems

A good example of these terrestrial-based systems is a class of radiotelephone systems operating under the FCC's Basic Exchange Telecommunications Radio Service (BETRS). These systems have been used in various rural telephony installations in the U.S.A. and Canada, and are becoming increasingly popular in many other parts of the world. International Mobile Machines Corporation and Telemobile Inc. [3] are examples of companies which have such products on the marketplace. A representative architecture of these systems is illustrated in Figure 1.

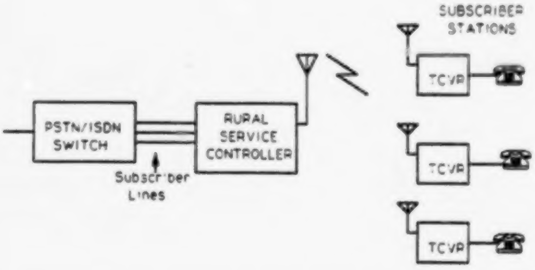

Figure 1 Typical Architecture of BETRS Systems

The Rural Service Controller (RSC) interfaces to a PSTN/ISDN switch on one side, and by radio, to remote subscriber terminals on the other. The systems can deliver high quality telecommunications services to remote customers, including low speed data transmission.

Although BETRS service in the U.S.A. has been allocated channel frequencies in the 150 MHz, 450 MHz and 800 MHz bands on a co-primary basis with other services, operational systems have been deployed primarily in the 450 MHz band. Part of the reason for using this band is because the 150 MHz band channels are very heavily used for IMTS public mobile telephone service in most rural areas of the U.S., and channels in the 800 MHz band are being used in some areas for trunked radio services.

When implemented in the 450 MHz band (such as systems currently operating in the U.S.A.), BETRS systems can extend telecommunications services over a range of about 40 - 50 miles radius from the RSC antenna. Although this may be adequate for many applications, countries which require longer coverage range may implement the service at lower frequencies, if available. With modular product designs, operation at other frequency bands should in general not necessitate extensive equipment re-designs, and may conceivably only involve the swapping of RF front ends.

3.2 Small Cellular Switches

The emergence of low-cost stand-alone cellular switches makes it economically feasible to introduce state-of-the-art mobile communications services in rural areas which would otherwise be considered too small or too distant to serve from a standard, and often large, centralized cellular MTSO. These switches are typically very modular, allowing economical system start-up with as low as 8 channels and gradual growth capabilities to accommodate future demand. The switches can interface directly to a local exchange closest to the rural areas to be served, avoiding the otherwise large expense of installing and maintaining long backhaul facilities to an urban cellular MTSO. Mobile, portable and fixed telecommunications applications can all be supported through the same system.

Through use of inter-system communications protocols such as specified in the EIA/TIA IS-41 Interim Standard, these small systems can be easily networked together for purposes of extending service coverage or to allow roaming and call hand-off between adjacent small cellular systems. Such a networking option based on small capacity switches may also provide an economical method for providing seamless coverage along highway corridors between communities.

Interworking of the small cellular systems with metropolitan-based large cellular systems should be fairly easy to accomplish, if there is ever a need to do so in the future. This makes small cellular systems quite attractive alternatives for providing advanced telecommunications services to less densely-populated areas.

4. USE OF SATELLITE-BASED SOLUTIONS

Satellite technology offers a convenient means for extending voice, data, and video services to scattered and sparsely populated rural locations which would otherwise be uneconomical to serve by terrestrial networks. Because the space segment of satellite communications is often very expensive and beyond economic justifiability of most individual public telecommunications administrations, the common practice is for service providers to lease or purchase transponder capacity on existing regional or international satellites. For example, many countries around the world have leased or purchased capacity on INTELSAT's satellites for their domestic communications. In this case, whole or partial transponders can be leased by members of the organization [4].

4.1 Fixed Service Applications

A typical satellite system configuration for extending fixed telecommunications services is illustrated in Figure 2.

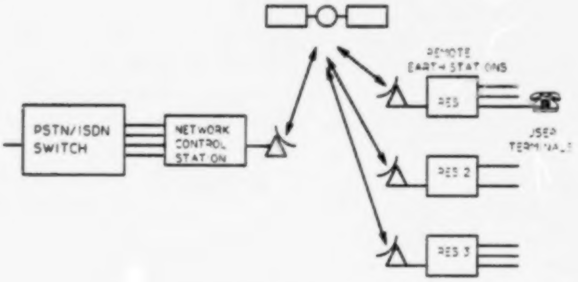

Figure 2 Typical Satellite Network Configuration

Subscriber stations can be located virtually anywhere within the footprint of the spacecraft used, and still have full access to the distant telecommunications network. In this case, the Network Control Station can very efficiently interface subscriber terminals connected to the Remote Earth Stations to the advanced telecommunication services of the metropolitan PSTN/ISDN network through a centralized Demand Assigned Multiple Access (DAMA) control of the satellite channels or, where justifiable, via permanently assigned (PAMA) channels.

The above network example illustrates a star configuration (i.e. point to multi-point), where all communications go through the NCS. This architecture is typically used in applications where the number of remote subscribers and traffic volume is significant enough to justify the often large expense of a dedicated NCS within an area or country. An alternative configuration which may prove more economic for low traffic applications (e.g. in some developing countries and other very thin route areas) is that where the NCS is shared by a number of countries or organizations, and centralized mesh DAMA control is used to provide point-to-point connectivity within each individual sub-network without requiring double hops over the satellite. This configuration is illustrated in Figure 3.

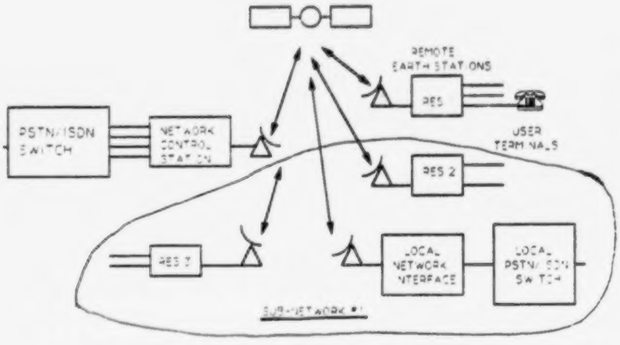

Figure 3 Shared NCS Configuration

In this case, each sub-network has its own local interface to its own advanced telecommunications services, but shares the expense of the NCS with all other sub-network operators.

4.2 Use of VSAT Technology

Another available alternative based on satellite technology is the use of Very Small Aperture Terminals (VSAT). Although initially optimized for data networking between a central hub and remote data terminals, VSAT systems are becoming increasing popular as the systems of choice for all business communications including voice, data, and video. In the U.S.A. for example, over 600 VSAT networks are currently in operation, including networks for K-mart, Chrysler, E.D. Jones, and Xerox Computer Services.

VSAT hub station prices average around $400,000, with remote VSAT terminals priced at about $10,000 each (two-way terminal, installed) [5]. Once the initial cost is expended, however, the monthly space segment rate is only between $200 and $800, making it a fairly inexpensive alternative for extending advanced services over large geographical areas. As with the conventional satellite network example of Figure 2, VSAT hub station costs can be reduced by sharing the hub station with other businesses.

Examples of products capable of extending advanced telecommunication services over satellite links are given below.

Spar Aerospace [6, 7]
Spar Aerospace has designed a satellite terminal which operates in both the C- and Ku-bands to offer data transmission at rates of 512 Kbps to 6 Mbps. This technology, named "TSAT," can be used to cost-effectively deliver basic and primary rate ISDN, X.25, and circuit switched data and voice to remote locations using 1.8 to 2.4 meter terminals at approximately $60,000 each. The configuration utilizes a single hop from point-to-point rather than through a central node as in VSAT technology.

Vortech and Hughes [8]
Vortech Data, Inc. and Hughes Network Systems have jointly developed a VSAT system using a proprietary multiple access method to provide on demand 512 Kbps data service. The system can connect to thousands of remote terminals under the control of a central hub station, although no hub-based packet switch nor double-hop is required. One application under test is medical imaging using 2.4 meter remote station antennas.

NASA's ACTS Satellite [9]
NASA will launch an Advanced Communications Technology Satellite (ACTS) in

May 1992 as a test system which will support the ISDN primary rate interface, performing on-board switching at the DS0 level. This single-hop system will utilize specially designed earth station (VSAT) terminals using Ka- band transmission (30/20 GHz). The system will also support 384 Kbps and 1.536 Mbps transmission speeds as defined by ISDN standards for the primary rate interface.

4.3 Mobile Communications Services

Although satellite-based mobile communications capability already exists in most parts of the world, use of such systems has until now almost exclusively remained with large organizations which have requirements for wide-area voice and data communications. INMARSAT, for example, has been providing mobile communication services to shipping and airline industries via satellite since 1982. Using satellites in geostationary orbit over the Atlantic, Pacific and Indian Oceans, the INMARSAT system gives almost global coverage. In the U.S.A., both Qualcomm and Geostar Corporation offer mobile data communications capabilities over satellite, with present clientelle consisting primarily of large trucking firms and some government agencies.

The planned introduction of a new class of mobile satellite systems (MSS) in various parts of the world around the 1992 time frame will begin a new era in the availability of advanced mobile communication services to organizations and individuals at large in remote locations. These systems are planned to support both voice and data communications for land, marine and aeronautical applications. In the land mobile application, MSS systems will operate much like modern-day cellular mobile systems, but with the extended coverage characteristic of satellite-based systems. Although design details have not been revealed, it is generally believed that the MSS systems will use spot beams and frequency re-use concepts for high spectrum efficiency and capacity. In this case, spot beams (cells) may be created by beam-forming antennas onboard the spacecraft.

It is anticipated that the land mobile service application will be through subscriber terminals of the same order in size as early generation cellular mobile terminals. Terminal prices at introduction are predicted to be high (in the neighborhood of $4,000), however this is expected to decline with increasing penetration and competition, much like witnessed in the prices of cellular mobile terminals.

MSS systems are currently believed to be in various stages of development in the U.S.A., Canada, Australia, Japan and Europe. The systems will operate in the L-band around 1.6 GHz, per allocations made by the ITU at the 1987 Mobile WARC.

5. EXTENDING INFORMATION SERVICES

Electronic messaging, videotex, EDI, video, and other information services can be delivered to remote locations via satellite without requiring advanced telecommunications facilities to every user. Possible information services which could positively impact the social and economic climate throughout a region will be discussed.

Audio [10]

The National Association of Broadcasters (NAB) calculates that 92% of U.S. radio stations now use satellite receivers, 75% of which own their own dishes. Advantages over land-based systems include economy, quality, flexibility, and accessibility. Quality improvements are largely due to digitization of satellite services internationally. Ku-band capacity can now be utilized from 1.8 meter dishes for remote broadcasting.

Video

A VSAT system can support video conferencing and broadcasting economically, especially when coupled with video compression technology. This compression technology allows full-motion video to be transmitted using less information than normal and, thus less bandwidth is required. Current compression technology offers quality video transmission at 384 Kbps and even at 128 Kbps. Improvements in this technology are expected to continue.

High Definition TV (HDTV) systems will largely be competing with NTSC in the future with questions pertaining to its delivery mechanism. In satellite, C-band, Ku-band, or DBS (Direct Broadcast Satellite) could be used for transport. Preferences lean toward medium-power Ku-band or high-power DBS with 3 meter or 1 meter dishes required, respectively.

Data Applications

The data applications which are most economically handled with VSAT technology are for businesses that are widely distributed, such as hotel chains and department stores. Reservation and point-of-sale systems are used respectively to connect hotels and stores to centralized databases. The point-of-sale applications include credit verification, order entry, and inventory management. Note that these networks, once established, may also be used for voice and video applications.

The financial sector similarly can utilize VSAT networks to interconnect automated teller machines with a centralized host. This same network may be used for administrative data transfer between branch offices.

Videotex, Electronic Data Interchange (EDI), text messaging, and on-line data processing are example software applications which may utilize a VSAT network to interconnect remote PCs and terminals to a centralized host computer.

6. CONCLUSIONS

Wireless communications offers a strong alternative for providing remote access to advanced voice, data, and video services, especially in applications where the distances involved are very long or there are many scattered remote areas to be served. Although some of the products available for these applications are not yet fully compatible with advanced services such as ISDN, various manufacturers are in the process of upgrading their products to support these capabilities. Indications are that wireless network technologies will continue to keep pace with advancements in wireline network services, offering economical vehicles for narrowing the information gap between urban and rural areas.

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The Interaction of Supply and Demand: the Effect of Changing Technology on the Demand for Capacity in Submarine Cable Systems

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1. ABSTRACT

This paper examines the implications of the new cost structure for Submarine Cable Systems. It argues that the change in the economics of supply are so fundamental that this in itself affects the pattern of demand. It examines the new economics of supply in detail and explores how this is already in practice affecting the demand. It reaches the conclusion that demand will continue to expand as a direct response to the increased supply.

2. INTRODUCTION

Within what is variously called "The Information Explosion" or "The Information Revolution" there is a general recognition of the fact that the combination of digital signal processing and optical transmission allows undreamed of quantities of information to be processed and transmitted (or to be really up to date we should now say transported). Classical economic theory postulates that the price level for most goods and services is set by market forces at the point where the marginal cost of production equals the marginal propensity to consume. (S2). Changes such as the advent of digital processing and optical transmission are represented by a new supply curve, and a new equilibrium is established with a lower price and a greater volume. (S3).

One of the consequences of this theory is that if the marginal cost of production in the short term is zero, or close to zero, prices may well fall to a level at which suppliers are making a marginal return on their existing investment, but these price levels will not support investment in incremental capacity. As demand increases beyond the available supply, shortages develop and the price level rises to the point at which there is a return on new investment. (S4).

If we view the events of the last decade in the telecommunications industry in general, and the submarine cable industry in particular, in terms of this classical economic theory, we are driven to some interesting conclusions. The proposal is that a cycle exists: the pressure of demand growth has forced suppliers to develop new systems and thus a new supply curve. (S5). The economics of supply of optical systems lead to low marginal costs for circuits: demand grows and pressure to develop a new higher capacity system builds up once more.

Following the pattern of classical economic theory therefore, we will examine the supply and the demand side in turn.

3. THE NEW SUPPLY CURVE

If we return to our classical model (S6=3), the question of the quantities being expressed on the x-axis is important as the patterns vary with the definition of quantity. In the days of analogue systems, each new generation of systems was sold at a total price (in real terms) which was dearer than its predecessor: however the increase in capacity was greater than the increase in price, so that the unit cost per circuit was reduced.

This is clearly seen in this slide (S7), which shows the cost of successive transatlantic cable systems (in real terms) plotted against their capacity. In turn, this slide (S8) shows the cost per circuit of these same systems.

The other element in this part of the story is that over the last 15 years of the analogue era, the market, in system volume terms, was static. (S9). If we use cable-route kilometres as the measure of the market volume, the secular trend from 1970 to 1985 was static at 12,000 route km. per year.

This pattern came to a halt at 45MHz when it became clear that there was no scope for further viable expansion of co-axial system capacity. There is no need to go over that ground here: what is important is the impact that the switch to optical systems has had on the economics of supply.

The first notable factor (S10) is that the evolution of capacity on a single bearer against time is following the same trend line as analogue systems, off-set by a plateau between the arrival of the 45MHz analogue system and the launch of the 280 Mbit/s optical system, which had the same capacity per bearer. It is however important to register that the optical systems are making smaller relative increases more often. In addition, on average there was a new analogue system every 5 years: so far there has been a new optical system every two years.

The factors which make the economics of optical systems different are:

(1) (S11). The availability of multiple bearers in one cable. To double up the bearer in an analogue system just doubled the cost. An incremental bearer in a repeatered optical system adds typically 10 to 15% to the cost - and it is possible to have either 3 or 4 pairs of bearers (dependent on the supplier design) in current optical systems.

In fact, by interleaving repeaters it would be possible to extend this to 6 if necessary (though there would be power feed problems for trans-oceanic systems).

(2) (S12). The intrinsic cost IN PRODUCTION (as opposed to development) of doubling the bit rate is relatively small in relation to the total system cost.

(3) (S13). The increased repeater spacing available from the use of the 1550nm. window reduces the repeater content of the total system cost. Since it is in the repeater that most of the incremental cost of an additional bearer is found thus the incremental cost falls. (S14).

The effect of these factors is summed up dramatically when we go back to our earlier slide of total system cost, (S15=7) and extend it to show TAT-8 and TAT-9 adjusted to point-to-point US-UK systems (S15A). Independent of the capacity, we see a comparable total system which is falling in real terms.

It can be argued that we are going through a very rapid stage of technological change, and that this will also plateau. There is some truth in this: however we invite you to contemplate where the plateau is. In terms of wavelength there is no further improvement, but there is plenty of scope for progress in terms of bit-rate per source, multiple sources using WDM, and multiple bearers, where 6 are possible with existing cable designs interleaving the present generation of repeater housings. The capacity issue for the foreseeable future is not the practicable limit, but the method by which the required capacity is achieved - bit rate per transmitter, transmitters per bearer, or more bearers. (S16). It should also be noted that within the total cost of an optical system, cable and installation account for an increasing proportion, and the effect of the capacity increases on these elements is relatively small. Hence the increasingly flatter slope shown on the graph (S17=14) ie a lower incremental cost per circuit.

To sum up, optical submarine cable systems have a fundamentally different cost structure to co-axial systems, particularly in respect of the cost of incremental capacity (i.e, marginal cost). The current state of the development of optical technology is such that we are a long way from running into the limitations that co-axial technology reached at 45MHz. With 1550nm. technology, and 560 Mbit/s systems the cost of increasing capacity by the addition of a further fibre pair is $1,900 per 64kbit/s circuit on our nominal trans-atlantic route. The argument which we have been developing indicates that in real terms this figure will tend to fall in the future.

What we find ourselves with therefore, is an interesting circle. Using circuits as the unit of volume, the short term supply curve (S18) actually slopes downwards to the right, as at the present time systems are in general not being procured to their full potential capacity.

However, as the next part of this paper will show, this stimulates demand so that a new demand curve develops, and this in turn puts pressure on the suppliers to spend another tranche of R&D money albeit reluctantly to move the supply curve once more.

We therefore turn to the demand curve.

4. THE NEW DEMAND CURVE (S19)

In examining the supply side, we have concentrated on the cost of providing a circuit in a submarine cable system. However, when we start to look at the demand side we come up against an immediate practical problem - what demand are we measuring?

At the far end the user is the member of the public who picks (S20) up his telephone, or the businessman who puts his fax in the machine or goes to his video-conference room. Between them and the purchasers of a submarine cable there is a very complex set of distribution channels: in our case much more complex than in the case of the distribution of, say consumer durables or food, because:

(i) the bandwidth is being provided to a large number of markets with very different characteristics, and

(ii) within the chain there are a number of service providers who are adding value in very different amounts and in very different ways. To some end-users the bandwidth will represent the major element of the purchased service: to others the bandwidth will be an insignificant factor in the service being obtained.

For the purposes of this paper we have simplified this demand into two elements: the final user demand, and the distribution channels, which we suggest can be modelled as a series of relationsips between the purchasers of submarine cable systems through to the end users. We have looked at each of these in turn.

4.1 END-USER DEMAND

The scope for the increased use of bandwidth has been worked over fairly frequently. It is however worth reminding ourselves of these areas and considering the sort of effect they could have on the use of bandwidth. We have considered these under three broad headings.

4.1.1 (S21) MIGRATION ONTO THE OPTICAL NETWORK

This can be viewed in three subsets:

(i) Voice

(S22) Apart from the growth in POTS, which in itself will cause demand to continue to expand, the availability of a video-phone service seems inevitable.

(ii) Paper

(S23) The physical movement of pieces of paper as a form of communication will become very expensive and progressively slower as mail services become less busy and a bigger overhead has to be recovered over a smaller baseload. The explosion in demand brought about by the availability of cheap facsimile transmission is strong evidence of this.

(iii) People

(S24) There has been an enormous increase in the amount of travel in recent years, both national and international. In both cases demand has been stimulated by the availability of a free, or nearly free resource - in the case of the car, the motorist is rarely charged for the use of the road, and every major city in the developed world has seen what happens when it builds freeways to help the flow of traffic. Build a network, make it cheap to use, and demand will fill the trunk routes faster than any forecast. In the air, space comes free(ish) and look at the crowding of the airspace over many of the world's major airports. Two conclusions can be drawn from this. The first is that pressure will come, either by price or regulation, for growth in travel to be restricted, and this will force traffic (with considerably increased bandwidth hungry services) onto the optical network. The second conclusion is that if cost of use of the network approaches zero, demand will appear to use it.

4.2.2 DEMAND GROWTH FROM NEW PRESSURES (S25)

The previous section dealt with pressures arising from existing trends in communication. Beyond this there will be further growth arising from, for example, the industrial logic of international collaboration on major development programmes, such as the V2500 turbo fan engine project. In most high-technology areas the development costs of a new generation of a product or system is several times the cost of the preceding generation, and in many areas the total world market will only support a limited number of competing systems. This is already true of major airframes, mainframe computers, digital switches and major defence equipment systems - to name but a few. Successive generations will increase the list and reduce the number of competing systems in these areas. The result of this will be an increased number of international collaborative projects and a corresponding increase in the amount of information which will have to be transferred around the world, when moving the people will have become more difficult.

4.1.3 SCOPE FOR NEW FORMS OF WORLD TRADE (S26)

The final area which we are mentioning is a further extension of the ideas already mooted. The development of the western industrial economies was accompanied by a significant growth in world trade as the new manufactured products were sold around the world

We are now moving towards economies which are much more service based, and which in turn will require to import not the extracted raw materials of the industrial state, but the software skills of countries which have a greater supply of relatively low paid software engineers than employment for them. In turn the exported output of these economies will be in the form of bits rather than boxes. The sum effect of all these factors will, we believe create a demand for bandwidth which will soak up all the capacity which technology is able to deliver. Over and above the factors mentioned above, there are two others which are particularly difficult to quantify. Firstly, if bandwidth is cheap, users will become extravagant in using it. This will be especially true if it represents a small part of the service being bought. Secondly, there is the probability of an ignition of the entrepreneurial spirit in seizing the opportunities offered. Henry Ford saw the potential in the motor-car if it could be made cheap enough to create a mass market. In our own time Steve Jobs and Steve Wozniak in the USA and Clive Sinclair and Alan Sugar of the UK have shown how it is possible to create a mass market almost single handed if you can offer the right product at a previously unbelievable low price.

4.2 THE DISTRIBUTION CHANNELS (S27)

Thus far we have looked at demand from the screen of the end user. But these are not the people who will decide to buy a submarine cable system. However valid these arguments are, the systems will only be built if the owners of the systems believe the arguments, and also if the distribution channels exist to allow these services to be provided. Again, the forecast is encouraging. The first optical cable systems to be bought tended to be tailored to existing forecasts of traffic, which in turn tended to be extrapolations of past trends. (S28). The fact that incremental capacity in these new optical systems was on offer for a comparatively modest surcharge was often ignored, in the belief that it would never be required in the lifetime of the system. At an early stage of fibre optics some planners adopted a visionary approach - put the bandwidth there and it will get used - while others stayed with their extrapolations. Thus there are some bizarre contrasts: TASMAN-2 will provide 1.2 Gbit/s between Australia and New Zealand, while TAT-9 will provide 90 Mbit/s between Canada and Europe. This may have elements of a special case about it, but it is noteworthy that PTAT-1, which went into traffic in 1989 has 1.26 Gbit/s of capacity compared with the planned 1.12 Gbit/s which TAT-9 will provide at the end of 1991.

It must be said that in recent months there have been increasing signs that purchasers are in general moving round to the point of view that the incremental investment involved in taking high capacity options at the point of system procurement is worthwhile.

This has also co-incided with a general pulling forward of planned RFS dates for major systems. There is ample evidence to support the case that "we are all visionaries now" and that capacity plans are being based on the sort of assumptions which we have explored.

(S29). The final links in the chain are the channels from the System Purchasers to the fingers at the keyboard. Here there are two important factors.

(1) (S30). The process of de-regulation which is proceeding both nationally and internationally will allow new operators to enter, offering a wide range of services from straight resale of capacity to the provision of complex and expensive value added services. To return (briefly) to classical economic theory, demand will be stimulated both by the drop in price for straight resale which moves the market along the existing curve, and the provision of new services which will move the whole demand curve over to the right.

(2) (S31). The availability of bandwidth at low cost will induce corporate communications planners to think in terms of acquiring much larger chunks of capacity than before. Operators are already seeing requests for DS3 circuits on cables from customers who would never have been thought of as likely to want more than a T-1. There is a gradual reassessment going on of the trade-off between having idle capacity and instant bandwidth on demand, and the cheaper the bandwidth, the less the user will be likely to tolerate a long fill time for his screen. There is also evidence of a new approach to communications requirements happening as people think through the implications of cheap world-wide communications. We should not under-estimate the reaction of the communications manager who realises that we have given him a tool with which he could hope to reshape his own corporation!

5. CONCLUSION

(S32). We have ranged in a short period of time over a large number of issues, and it has not been possible to deal with all of them in detail. We have however explained how the application of optical transmission to submarine cable technology has revolutionised the economics of supply to lead us to a world in which the marginal cost of capacity has become very low and will decrease further. In addition we have examined the likely new demand patterns to show why it is our belief that these supply changes, coupled with some of the fundamental factors affecting the demand for bandwidth will lead to this huge capacity being filled.

VOICE MESSAGING MARKET:
ECONOMICS, STANDARDS, AND TRENDS

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1. ABSTRACT

Voice messaging has been viewed as an efficient means to improving business communication, and savings in voice traffic and network management. Voice messaging market evolves rapidly in the U.S., driven by hybrid technologies and increasing needs. Such impetus may push in achieving interworking standards. ISDN will have a major impact on VM market. The BOCs will be more active in VM business. A variety of voice services will be seen in the market.

2. GROWTH AND OPPORTUNITIES

Computerized voice messaging market emerged in the early 1980s, landmarked by the Rolm's introduction of PhoneMail systems to PBX in 1983 (CBX). The fundamental catalyst to expanding traditional boundaries of voice communication is computer technology. Today, voice messaging systems (VMS) market in the U.S. is characterized by fast computers, large-capacity storage media and proprietary networking schemes and user interfaces. This presents both prosperity and problems as discussed later. The U.S. voice messaging market was about $400 million in sales in 1988. With an annual growth rate of 30%, the voice messaging market may well reach $1.1 billion by 1992 (excluding the burgeoning audiotex market). The rapid VMS growth is the result of both service availability and market demands for advanced, hybrid voice communications systems.(1) This push-and-pull trend is likely to continue as a major impetus through the 1990s.

3. MARKET TUGS

The status of voice communications can be described as a mixed application of analog and digital technologies, especially in the areas of transmission, storage and processing. The VMS is experiencing the continuous evolution to digital networking. The use of high-speed modems has facilitated digitized voice communications. With a speed of 16 kb/s, for example, a 64 kb/s processing and switching device can significantly improve call throughput ratio and voice quality.

Functionally, voice messaging is a pro-active use of computers to record, process and distribute voice messages to one or more users. In terminology, voice messaging takes a large portion of voice mail services. In addition to the familiar features such as call forwarding, call waiting, conference call, and call selection, voice messaging provides robust networking schemes. For example, voice messaging makes partitioned mailboxes with different passwords for a number of users, so that the same message can be "broadcast" (distributed) to different locations. Messages may be sent immediately or appended. Another feature called "call delivery" allows the user to program his service to call him (or other people) at a later time, such as "agenda calls," "schedule calls," etc. This new service is expected to be available soon.

There are essentially two types of contenders in the voice messaing market today: the telcos (Bell operating companies and independent carriers) and VMS vendors. The voice messaging presents a lucrative market for the Bell operating companies (BOCs). The BOCs had been restricted by the FCC from entering the market until recently. In the March 1988 ruling, the court lifted bans in the Modified Final Judgment and allowed BOCs to provide enhanced services, such as voice mail, electronic mail and various information gateway services.(2)

Since then almost all seven Bell holding companies have conducted or announced voice mail trials.(3) The services are to be provided from central office (CO) based switches (Centrex) to residential and small business customers for a reasonable monthly fee (residential: $4-$10; business: $8-$18). The BOCs and independent exchange carriers may well take the advantage of their state-of-the-art Centrex services, standards adherence and available wiring systems. GTE, for example, has announced "Omega" products which utilize fault-tolerant computers with VoiceServer from its Centrex. However, Centrex voice service is suffering from a shortage of adequate voice original equipment manufacturer (OEM) products. Most VMS products only have about 60-port capabilities, which can handle up to several thousand users, while a CO-based service should be able to process hundreds of thousands of calls. This problem is expected to be resolved when voice service subscription rates take off. Figure 1 is a conceptual configuration of a CO-based voice system.

FIGURE 1

CENTRAL OFFICE BASED VOICE MAIL SYSTEM

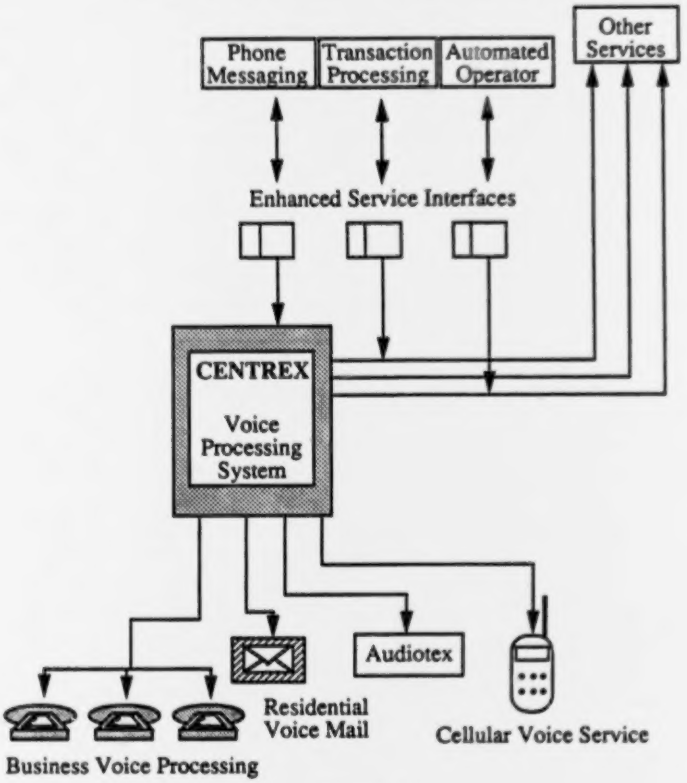
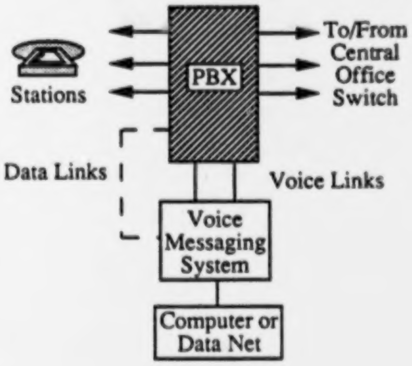

Phone Messaging
Transaction Processing
Automated Operator
Other Services
Enhanced Service Interfaces
CENTREX
Voice Processing System
Residential Voice Mail
Audiotex
Cellular Voice Service
Business Voice Processing

FIGURE 2

PBX-BASED VOICE SYSTEM


PBX
Stations
To/From Central Office Switch
Data Links
Voice Links
Voice Messaging System
Computer or Data Net

When PBX receives a call, it can process the call for designated nodes (other stations), or retrieve requested services from database through PBX's data module.

The other heavyweight player in the voice messaging market is VMS vendors. They sell voice processing systems directly to businesses who use standalone PBXs at either department or corporate levels. The major PBX makers also deploy proprietary VMS in their products, such as Rolm (PhoneMail), AT&T (Audix) and Northern Telecom (Meridian Mail). The initial VMS market growth was slow due primarily to expensive computer storage and processing power. Once the barriers were overcome, the voice messaging enjoyed a rapid growth. Figure 2 depicts a typical PBX-based voice system. Currently, large systems (24-64 ports) account for 51% of the market, medium-sized (3-16 ports) are about 47%, and small, PC-based systems (1-3 ports) are about 2%. Figure 3 tallies the current voice market shared by PBX and VMS vendors.

FIGURE 3

VOICE MAIL MARKET, 1987
(Systems Installed)

Rolm Systems Division*	28%
VMX/OPCOM**	20%
Octel Communications Corp.	12%
AT&T	9%
Centigram Corp.	8%
Wang Laboratories, Inc.	7%
Genesis Electronics Corp.	7%
Others	9%

* IBM has sold Rolm division to Siemens to be completed in 1990.
** VMX, Inc. and OPCOM merged in 1987.

The costs for installing VMS equipped PBXs are much higher compared to using Centrex services. They typically range between $10,000 to $50,000, depending on application needs, such as the number of users and mailbox distribution scale. Nevertheless, demand for efficient internal and external communication, customized user interfaces and PBX's traffic handling capability may well justify the investment. Although PC-based voice systems ar suitable for small businesses, they may not increase rapidly compared to PBXs and large computer-based systems, because the former's capability of handling voice traffic is low and inefficient (usually limited to 5-30 voice users). As a result, the benefits are not significant enough to justify the investment.

4. TRAFFIC ECONOMICS

Although the voice messaging services have been used for almost a decade, their economic implications had rarely been studied until recently. A number of studies indicate that voice systems can make high time and line savings from reduced callbacks, written memos, and rambling talks on the phone. Consequently, voice systems help save response and information processing time, improve office productivity and customer relationship.(4)

In principle, voice messaging should be able to accommodate a large array of communication needs. In business communication environment, voice traffic accounts for about 90-95%, while data traffic accounts for less than 10%. Corporate spending on communications systems is phenomenal, usually more than 50% of the total annual budget. Despite hefty investments, voice communication always seems to be less efficient than expected. Statistics show that 75% of all business calls are never completed and require follow-up calls. One of the reasons such a large portion of calls cannot be completed is that 60% of the time when calls come in, the phone is not answered because people are on the other line, at meetings, or out on the road.(5) It is convincing evidence that in order to justify systems' cost-effectiveness and improve productivity, voice messaging services must be understood and managed as a strategic communication means rather than an expedient substitute.

When purchasing or using a voice system, the critical concern is traffic. A telephone system is designed at a capacity for average traffic (usually on a monthly basis), rather than based on peak conditions. Traffic blocking is caused by either high line usage or no circuit available to connect the call, although in the latter situation the line is not in use. Taking the above situation as an example, when the intended call recipient is not present when the phone rings, the call cannot be completed even though that particular line is used. An example for the second situation would be, the number of incoming calls exceed the PBX's capacity, so that although the line is free, no calls can be switched through. When blocking occurs, a busy signal is received by the caller ("network busy condition" as used in the traffic engineering). In both situations, the call efficiency is zero. If a large portion of incoming (or outgoing) calls cannot be completed, the productivity level will be low, and line/time is wasted. As a productivity improvement tool, voice messaging is suited to increase call/complete ratio, such as saving the call, processing and distributing the call to another person as necessary. In general, the average blocking rate determines the capacity of a voice messaging system.

Another consideration for systems economic implications is "grade of service," that is, the probability of a call being blocked. The lower the grade-of-service, the less likely a blocking condition occurs, but the costs for implementing and maintaining the system will be higher. For PBXs, the grade-of-service is usually engineered at P.02-.05 range, a balance between desired call-complete ratio and reasonable costs. Some voice messaging features such as call forwarding, speed dialing, may be critical for certain businesses that require high throughput from average-traffic engineered PBX systems. For those companies, the blocking rate may be evidently higher during busy periods than other times the system was initially designed for.

5. STANDARDS

At present, there are about 45 vendors in the U.S. VMS market, most of them use proprietary user-interfaces and networking schemes. This has caused serious concerns on standards from both users and vendors. A few user-vendor groups and forums have been established dedicated to voice messaging standard specifications in inter-vendor networking environment (interworking). However, limited impact has hit the market so far.

The major bottleneck is interworking standards. For example, a voice message from the company's headquarters is sent to its dispersed branches. This process may require protocol conversion when the message reaches a different voice system used by a branch office. Likewise, business transactions between two companies may encounter different VMS systems. The interworking plight gets worse when some of the voice messaging features are utilized. For example, a message may be appended to the response and forwarded to a third party. In these situations, voice interworking may not function at all, or at low efficiency, if networking standards are unresolved.

The interworking standards essentially concern the signaling protocols, a set of standards dealing with exchange of messages, and the format the message is converted, transmitted and received. So far, a number of signaling protocols have been proposed and studied, among which the ones that adhere to international standards have drawn particular attention from VMS vendors. For example, it has been suggested the use of X.400, a standard for messaging and document interchange recommended by the CCITT. The adoption of existing international standards has several advantages for the VMS market. First, vendors can easily use off-the-shelf X.400 complied software with some modifications, thus avoiding original development that is labor-intensive and time consuming. Second, promoting X.400 uniformity will pay off in the future when large networks are needed for communications services integration.

There has been considerable debate about digital coding methods for voice transmission across different systems. Since each system is designed using proprietary methods, each has a unique way to convert voice analog signals and store them internally in digital forms. None of current methods is designed to target bit errors from different systems. The currently available standard for voice/digital compression is at 32 kb/s. The CCITT may be considering alternative recommendation for 16 kb/s compression methods. Conforming to international standards will enable different systems to engage in the same protocol schemes, therefore to expand VMS's interoperability and to improve performance and efficiency.

However, it is anticipated that the adoption of international messaging standards may not turn out to be a fast switch. People have hoped that the adoption of CCITT's Group III facsimile standards resulting in quick penetration of fax machines will be the scenario for voice messaging market, but it should be reminded that the two markets are not parallel in applications characteristics. In general, people give more weight to the information in written forms than in oral forms. Fax communication has shown an effective extension of written communication, whereas voice messaging is often perceived as "back-up" of telephone. At least for the time being, voice messaging systems vendors do not show a very strong commitment to standard conformation, or maybe it is the result of the yet weak user pressures. Whatever the case, the fax and voice transmissions are hardly comparable in terms of their functions as perceived in business communication environment. Right or wrong, this perception will exist among MIS managers and business users for some time. During this period, the voice messaging market will continue to grow, but its standardization may take a slow pace.

6. FUTURE TRENDS

Voice messaging presents a robust market in the United States. The scenario of fast growth has been widely taken for the next few years.

In the meantime, the market is showing a favorable attitude toward voice processing services. More companies, large and small, have come to realize the economic benefits and investment return from voice systems, that will, eventually, enhance the productivity level.

For the "push" part of the scenario, meanwhile, new voice features are being added to the existing services, gradually building a unique communication environment. We may even see some of the services go international, such as talking yellow pages (audio databases).

Specifically, the following trends may be observed in the market between 1989 and 1993.

1. The telephone companies, namely, BOCs and independent carriers, will take more aggressive approach in voice messaging market. Ameritech acquired Tigon Corp., an OEM voice systems vendor in 1988, a sign of taking lead to provide more voice services to users. Although it is unlikely that acquisition of VMS vendors from telcos will forge a major trend, it has strongly suggested the intention for the new market and commitment from telcos.

2. The voice messaging market will continuously be dichotomized between CO-based services (Centrex) and standalone PBXs. Predictions that Centrex would lose voice services to PBX on the ground of service features and cost may not be the case, at

least in the near future. With standard protocol, sophisticated configuration, and software support and savings in management and maintenance, Centrex is making a strong comeback in winning a number of industry segments.

3. PBX and OEM vendors, meanwhile, will deliver specific plans for the voice processing market. At present, AT&T, Fujitsu, NEC and Northern Telecom offer voice processing capabilities in their PBX product lines. More features will be available in the market. However, given the fact that the price of PBX will likely maintain stable at least in the near future, its growth rate will be basically flat. Improvements and new services of PBX functionality are the key to new sales levels.

4. The price of VMS will continue to come down. A lower price will be a function of market size and service features that are almost certainly to occur in the near future. Specifically, the current price range of $5,000-$8,000 per voice port will come down to the $2,000-$3,000 range during the next 3-4 years.

5. Cellular voice service will emerge strong. Cellular phone market has been growing at a startling pace. Within a short period of five years, the total market had exceeded 2 million sets by 1988. Cellular voice messaging will allow a user to screen his calls while on the road. Other paging services will be added to traditional cellular services. The cellular messaging is likely to become an alluring market and attract fierce competition.

6. The voice processing market will embrace the trend of systems integration. As progress made in the integrated services digital networks (ISDN), voice processing capability will become an important enhancement in an ISDN environment. More voice processing products with ISDN specified protocols will enter the market in the 1990s.

# # #

REFERENCES & NOTES

(1) A recent survey of major Fortune 500 executives showed the most important issue (of response rate 92%) is "communication with top management, functional managers and endusers." See The Changing Shape of IS: A Second Look, Andersen Consulting/Arthur Andersen & Co., 1989.

(2) This trend is believed to make a strong appearance in the 1990s. It has been reinforced by the recent court's ruling that AT&T is allowed to engage in electronic publishing business beginning in August 1989. The lift is expected to have significant impact on video-delivered information services, such as videotex, and telephone-delivered services, as well as other telcos and information service providers.

(3) For details of BOCs' voice service trials, see BOC Week, April 11; May 2, 1988. Enhanced Services Outlook, April 1988. FCC Week, May 30, 1988. Telecommunications Reports, April 4, 1988. Telephone News, April 25, 1988.

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THE CHALLENGES OF THE TELECOMMUNICATIONS ENTREPRENEUR

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1. ABSTRACT

The telecommunications entrepreneur is faced with almost insurmountable challenges with the wake of over five years of deregulation, the aggressive moves of the large telecommunications companies, the Far East challenge and the European Economic Community in 1992. The U.S. government and industry associations are starting to address some of these challenges but the financial institutions and venture capitalists still do not allow for true strategic planning by the entrepreneur to meet the challenges.

2. INTRODUCTION

2.1. OVERVIEW

This paper is based upon the first hand experiences of U.S. telecommunications and electronics entrepreneurs. It uses the background and history of members of the American Electronics Association and the specific experiences of the author. The major challenges to the telecommunications entrepreneurs are described with examples of the challenges. Recommendations are made concerning the actions to be taken to face each of the challenges. Emphasis is placed on how entrepreneurs can make their products and services available to the countries encompassed by the PTC.

2.2. ENVIRONMENT

The current environment in which the telecommunications entrepreneur must operate is one of constant change. The deregulation that is permeating many of the countries has both positive and negative effects. In general those companies and organizations that participate in the studies, hearings and government inquiries leading up to deregulation are the large national and international organizations who have the time, money and resources to put forward their positions. Often times these positions do not support the small entrepreneurial companies or the public. This is also true when defining standards.

On the positive side telecommunications entrepreneurs can develop leading edge products and sell them directly to end users. They can also become interconnects and install products and systems. They can compete with each other and with the large corporations. The negative side is that deregulation has allowed for other large corporations to enter the market including those from other countries. The marketing practice of these companies and the marketing clout makes it difficult for the small company to compete. In a number of cases the entrepreneurial company is dependent upon the larger companies to integrate their technologies into the large company's products or for the large company to resell their products. This limits the market and the availability of products to end users. In fact in this instance the large companies have control over the way the entrepreneurial companies operate and what technologies are to be used to develop into products.

Mundane areas such as product liability insurance, workmans compensation, strict regulation concerning business operations, import/export bureaucracy and a variety of tax laws in many instances can put a company out of business. Large companies can handle such situations with appropriate staff while small entrepreneurial companies have to resort to informal networks of companies and trade organizations for support and information.

Within this basic environment the telecommunications entrepreneur must meet not only the challenges of continual deregulation but the aggressive moves of large telecommunications companies, the entry of companies from the Far East and both the threat and opportunity of the EEC by the end of 1992.

3. MAJOR CHALLENGES

3.1 MOVES BY LARGE TELECOMMUNICATIONS COMPANIES

The large telecommunications companies consist of the multibillion dollar telecommunications manufacturers, the Regional Bell Operating companies and their holding companies, the major interexchange or long distance carriers and the major computer companies.

In general these companies are forming a variety of alliances that make them stronger in their domination of the telecommunications market. their clout in terms of PR, advertising and control of their customer base leaves little room for the hi-tech start-up company. To compete in this environment the entrepreneur must be extremely creative.

3.2 THE FAR EAST

The liberal telecommunications environment in the U.S. which is being followed by some of the countries allows for ease of entry of foreign telecommunications companies into these markets. Favored nation relationships, low tariffs, the difference in methods of doing business have allowed the market entry of companies from the Far East with inexpensive products.

Japan, Korea, Singapore and Hong Kong dominate or at least have a major portion of the manufacturing and sales of customer premise equipment.

Many of the major Far Eastern companies obtain their base from their unique relationship with the country government owned or recently privatized monopoly local telephone company. These large telecommunications, and often times conglomerates with finance institutions as sister companies, are coming into the U.S. market on equal footing with the telecommunications entrepreneur. This again requires the entrepreneur to be creative to compete or to offer part of his company or technology to the large companies in order to survive.

3.3. THE EEC AND DECEMBER 31, 1992

The EEC is scheduled to integrate all its members into one major market without barriers between its members by the end of 1992. This is both a challenge and opportunity to the entrepreneur. A challenge in that there will still be non-tariff trade barriers by country consisting of regulations, standards and certification / homologation. For the entrepreneur to do business in Europe he must be capable of producing products to meet such requirements. This is the same situation if he wants to sell products in the countries in the Far East.

The large European telecommunications companies are forming alliances with U.S. companies for example, IBM and Siemens and ATT and Italtel of Italy which in most cases leaves out the smaller companies.

3.4. FINANCIAL SUPPORT

The telecommunications entrepreneur requires financing to develop the product line and get the products to market. Such support normally starts with the entrepreneur's own finances. For further growth financial support can come from strategic partners, venture capitalists, banks, and at times federal and state institutions.

The U.S. is geared to quarterly and annual reports. It is also geared to how fast money can be made. In almost all cases, with the exception of large strategic partners, the investors want their investment back with a major return and/or interest in a relatively short period of time.

It is up to the entrepreneur to manage finances, and with minimal backing, to either land an initial contract with a major company, or, in normally short meetings with Harvard business school types, show business plans that prove that the company is worth an investment.

3.5 DEREGULATION

This relatively new environment gave the telecommunications entrepreneur a bad name. Many start-up companies that eventually went public or had major investments by venture capitalists are either out of business or operating at continuous losses. Hundreds of customer premise equipment manufacturers, interexchange carriers and interconnect companies have gone out of business. The next group that can be affected are the private payphone companies and the private operator assistance companies.

Deregulation still left the Regional Holding Companies (RHCs) regulated and due to these regulations have limited the marketing of the entrepreneurs' products and services to the RHCs. The environment is still in disarray. In a number of instances where the entrepreneurs had the possibilities to form alliances with the RHCs, the legal interpretation of the regulations concerning research and development, and manufacturing, caused the business arrangement to be canceled or postponed indefinitely.

For the telecommunications entrepreneur to survive he needs to be connected to an RHC or one of the major independent telcos in some type of long term business relationship.

3.6 HOW TO MAKE PRODUCTS AVAILABLE TO PTC COUNTRIES

The entrepreneurial companies' goal is to make profitable leading edge telecommunications products available to their customers. Unfortunately most entrepreneurial companies do not have the resources or the expertise to expand beyond their borders. The challenge is for the entrepreneur to identify specific markets in the Pacific Hemisphere and to identify viable partners located in those markets to assist in making products available at competitive prices.

4. DETAILED DESCRIPTIONS OF CHALLENGES WITH EXAMPLES

4.1 PREDATORY PRACTICES OF LARGE DOMESTIC AND INTERNATIONAL COMPANIES

Large corporations have access to cadres of lawyers and war chests to fight legal battles. They also have the funds to finance individuals whose sole responsibilities are to influence national and international standards in order to enhance their market position. Employees of small entrepreneurial companies do not have the funds to travel worldwide to attend standards meetings where decisions are made and this is obviously known by the large entities. These limitations are also true with country standards people who represent financially strapped countries.

Predatory practices consist of pre-announcement of products, give aways, patent infringement, industrial espionage, slander, and standards domination. A number of examples will be cited without naming the organizations involved.

4.1.1 PRE-ANNOUNCEMENTS

Company X (a large corporation) identified the need for leading edge products through such products being supplied by company Y (an entrepreneurial company) to the U.S. military. Although company X's products were in the development stage and not commercially available they pre-announced the product line at trade shows and through selected trade publications. The effect this had on the market place was to slow down the acceptance of company Y's products since a number of organizations would prefer to do business with a large company than with a smaller one. As of today the product line of company X is not commercially available and it was pre-announced over two years ago.

4.1.2 GIVE AWAYS

Large company A issued a Request For Proposal for the development of a product. Small company B and large company C were among the bidders. Company C bid a development of a product which did not fit the initial specifications, but the bid was at no cost to large company A. The reason for this was that company C expected, if successful, that company A would order large quantities of the product from them. In no way could small company B finance a major development on the hopes of getting the business.

4.1.3 PATENT INFRINGEMENT

Large companies are well aware of the limitations of the entrepreneurial companies in the area of patent protection. In particular when trying to protect patents in foreign countries. To insure that the company patents and technical know how are protected, outside legal counsel must be maintained at considerable expense and the entrepreneur must be prepared to enter courtroom battles.

There have been numerous cases where a small company has taken on a large company in the courtroom where the legal costs and time involved have caused the demise of the entrepreneurial company whether or not they won.

Large telecommunications companies purchase products from entrepreneurs, test them and reverse engineer them to try to avoid patent infringement. However, when broad patents are involved patent infringement is very difficult to avoid.

4.1.4 INDUSTRIAL ESPIONAGE

This is an extremely touchy area. The definition of industrial espionage includes the normal practice where there is a make or buy decision by a large corporation. In a majority of instances large companies legitimately issue Requests For Proposals which include the disclaimer that they may not go ahead with the purchase of products and services and it does not preclude them developing a product in the future.

The start-up company is anxious to obtain the business from large companies and will sign confidential non-disclosures, give very specific information, including that pertaining to future products, and when given the carrot of a potential strategic partnership, gives much more.

There was a case where start-up company S was approached by large company L where all that was described in the preceding paragraph took place, including company S supplying company L with a proposal with prices and schedules. At the last minute company L canceled a decision making meeting with company S and stated that they were no longer going ahead with the product line. In less than a year later company L announced their own internally developed product line with some very similar functions to those proposed by company S and have competed with company S since that time.

4.1.5 SLANDER AND DEFAMATION

Slander and defamation is difficult to prove and normally a company is advised by a customer or distributor that such alleged statements have been made. Usually such statements take the form of those regarding the limited resources and financial background of the small company. Some statements even go so far as to hint at the possible demise of the start-up company. There are large companies that have corporate codes of conduct and enforce them to ensure other companies are not defamed by their employees. Unfortunately a number of nationally and internationally based telecommunications companies do not abide by such ethical and moral practices.

4.1.6 STANDARDS DOMINATION

It is a known fact that standards, in most instances, are driven by the large telecommunications entities. Standards if not defined properly and instituted too soon can hinder the development of technology. In most instances if the entrepreneurial company is not heavily financed it cannot maintain its presence nor positions in country and international standards bodies.

Large international telecommunications entities with operations in most major countries can easily dominate specific standards and coordinate positions on an international scale. There is very little room for a small entity to match such force.

Small companies have developed and shipped leading edge products only to find out that at a future date, standards have been voted on and put in place by ISO and/or the CCITT that cannot be conformed to by its product line.

The schedules and meeting places for both the national and international standards bodies are normally defined by the large entities which requires a significant travel budget thus limiting the participation of the small hi-tech companies.

There have been cases when a relatively small number of "experts" have defined the telecommunications and data processing standards for the world primarily in support of their own corporate goals.

4.2 MOVES BY FAR EASTERN BASED INTERNATIONAL COMPANIES

The challenges posed by international companies based in the Far East include strategic alliances of government and industry, predatory pricing and the misuse of patents and know how.

4.2.1 STRATEGIC ALLIANCES

It is a challenge to compete with a large U.S. multinational; it is a greater challenge to compete with a multinational from the Far East. The telecommunciations entrepreneur is in fact competing with major Far Eastern conglomerates that have the full support of their governments in a coordinated effort in competing in the telecommunications market in target countries. Included in many of these conglomerates are financial institutions and trading companies. In addition, when the large multinational companies establish foreign subsidiaries, they still favor suppliers and subcontractors from their own countries.

The laws governing cooperative bidding, exchanging of information, and a number of other business practices differ from country to country. The Far Eastern ministers responsible for international trade and industry have worked hand in hand with their large telecommunications companies in establishing strategic plans, identifying target industries, identifying target countries, setting national and international standards positions and showing one coordinated position to the outside world. This is not normally the case in the United States.

4.2.2 PREDATORY PRICING (1) (2)

Predatory pricing includes dumping. Only recently have the dumping allegations made by AT&T and Comdial been investigated by the U.S. Department of Commerce and found to have merit with a number of Far Eastern telecommunications companies cited. The companies cited included those in the countries of Japan, South Korea and Taiwan.

In other instances pre-announcements of products have been made at major trade shows, and through advertising showing pictures of the products along with lower prices than those offered by small hi-tech companies.

A predatory practice is to bid lower prices with little or no profit margin, knock off the competition and then increase the prices once the competition is non-existent. This pattern has a major effect on the business of the telecommunications entrepreneur.

4.2.3 MISUSE OF PATENTS AND KNOW HOW

The small hi-tech start-up company has little or no understanding of the patent and copyright laws of the Far East. They normally file in the U.S. first and may file in the Far East at the appropriate time. If they do file in the Far East they operate under the assumption that the patent process is identical to that of the U.S. and that all that is required are direct translations.

In the case where they do not file it is easy for the large Far Eastern entities to have their U.S. subsidiaries peruse the U.S. filing, send information to the home country headquarters and to have at a minimum, a similar patent filed under their name in the home country.

In the case where the U.S. entrepreneur files in the Far Eastern country, the time for approval can take up to six years and during that time the patent is available for perusal. In certain countries broad patents are not applicable as in the U.S. and therefore a U.S. broad patent can be modified and submitted as a filing by the large Far Eastern entity in the home country.

The result of the patent situation differences is that similar products to those of the start up company can find their way back to the start-up's home market and cause a major loss of revenue.

Another twist in the patent and know how issue is that many telecommunications entrepreneurs have been convinced to manufacture in the Far East. They make arrangements with a Far Eastern manufacturer only to realize at a later date that the manufacturer is marketing a very similar product in the U.S.

The challenge is for the entrepreneur to protect his technology, know how and market.

4.3 THE CHALLENGE OF THE EUROPEAN ECONOMIC COMMUNITY (3)

The telecommunications entities of the EEC and their respective regulatory/standards bodies are moving toward harmonization. The small hi-tech companies would like to take advantage of this market and at the same time insure that they can compete with the EEC companies within their own markets.

The EEC challenge includes the formation of new telecommunications alliances, favored suppliers by the PTTs, accommodating the telecommunications environment of the individual countries and the identification of legitimate distributors and agents.

4.3.1 FORMATION OF TELECOMMUNICATIONS ALLIANCES (4)

The large European telecommunications companies and their U.S. counterparts are forming a number of alliances. There are also alliances being formed between European entities. AT&T, IBM and several of the Regional Holding Companies have formed and are forming joint ventures with European counterparts within Europe. Companies such as GEC and Siemens have joined forced to acquire Plessey.

The small telecommunications company has to compete in this environment and understand the intricacies of these alliances. The smaller companies in general do not have the clout to form such international alliances on their own.

4.3.2 FAVORED PTT SUPPLIERS

Traditionally each of the major European PTTs or telephone companies favored their indigenous suppliers. In fact this situation has continued up to now. One of the few product lines that have not transcended the European borders are telecommunications products. Relatively speaking it is still a low percentage in terms of suppliers from one country supplying product to the PTTs of another.

With the steps towards harmonization and a homogeneous market it can be expected that the EEC PTTs will continue to favor these suppliers within the EEC borders. The large North American and Far Eastern entities have and will establish EEC operations. It is the smaller telecommunications companies not located in the EEC that have the challenge to organize to address that market and find a way to compete.

4.3.3 NEW CHALLENGES TO BUSINESS IN THE U.S.

With deregulation and the strengthening of the European telecommunications entities major moves have been made in to the U.S. marketplace by most of the significant European telecommunications entities. This has increased the number of large competitors the telecommunications entrepreneur must deal with. These European companies like their Far Eastern counterparts have significant support from their governments and have coordinated their efforts in such areas as telecommunications standards and regulations.

The small telecommunications company must learn how to become sophisticated enough to deal with this new type of competitor.

4.3.4 IMPACT OF EASTERN EUROPE

The challenges of eastern Europe and the effect on the EEC and the rest of the world are still to be understood. It can be assumed that two things will happen. One is that new markets will become available and two, that Western Europe will have access to inexpensive but well educated labor.

Eastern Europe will give Western Europe the capability to compete with the Far East in that telecommunications equipment can be manufactured in Europe at competitive prices.

4.4. THE FINANCIAL CHALLENGES (5)

The U.S. financial environment is one of the major challenges. This is due to the short term measurement practice by quarter and by years in the U.S. In particular, if the company is privately held it doesn't matter how long it may have done business with a financial institution or had a number of successful years for its investors, just one bad year will cause the relationship to change dramatically. There are a multitude of examples where the financial institution becomes intolerant and the investors replace the top management due to one bad period.

4.4.1 VENTURE CAPITAL

The venture capitalists as their name implies go into a venture and capitalize on it normally through an Initial Public Offering (IPO) or an acquisition. Prior to getting involved with a venture capitalist group the telecommunications entrepreneur should be cognizant of the pros and cons of such an involvement. Due to the need for capital a number of start-up companies have been involved with venture capitalists that have taken the majority shares, controlled the company and eventually forced out the entrepreneur.

4.4.2 STRATEGIC PARTNERS

The challenge is to find a strategic partner which is the optimum way of obtaining financing, additional management, an established market and a distribution channel. The key is to maintain all the advantages of the small company under the umbrella of the large company. The exposure is losing the corporate culture of the small company.

4.4.3 BANKS

Banks do not understand hi-tech telecommunications. They are still only interested in companies with real assets such as buildings, land and equipment. They do not understand technology and know how as an asset.

Banks are not giving major loans to small companies based on inventory and accounts receivables without other assets as collateral. Even if the entrepreneur is successful the banks still require personal guarantees such as assets including saving, stock, and real property.

4.5 CHALLENGES POSED BY DEREGULATION (7)

Congress is reviewing the Modified Final Judgment, the role of the FCC and the role of the Justice Department. They are reviewing the regulations of the Regional Holding Companies and the Interexchange Carriers in light of the broader issues such as balance of trade and the loss of technological leadership.

4.5.1 REGIONAL HOLDING COMPANIES (8)

The Regional Holding Companies (RHCs) and their subsidiaries including the Bell Operating Companies are the dominant players in the telecommunications environment as are their counterparts in the Pacific Hemisphere countries. They are the prime customers for telecommunications products companies.

The RHCs are becoming the major interconnect companies along with ATT. They are the resellers of telecommunications equipment to the end user in competition with the independent smaller interconnects. These companies purchase a major percentage of their equipment from manufacturers outside the U.S.:a motivation to do this is their limitation by the MFJ in research and development.

The RHCs cannot invest in the telecommunications entrepreneurial companies that perform research and development and manufacture because of the MFJ limitation; this then limits their support of the U.S. start-up companies.

The RHCs are not allowed to become long distance telephone companies even on a regional basis such as between the states where they offer local telephone services. In addition, they cannot offer enhanced services such as the provision of on-line databases and sophisticated computer/communications offerings.

The limitation on the RHCs limits the opportunities for the small companies to provide products and services to and through them. Others argue that they will become major competitors to small companies and drive those companies out of business. However, if the RHCs do not enter the market other large companies will fill the gap, including those coming from outside the U.S.

The RHCs are beginning to expand their investment outside the U.S. since the MFJ allows them to manufacture outside the U.S. for non-U.S markets. Once this happens less money will be available for the U.S. start-ups.

The interconnect market in particular products such as telephones and key systems is dominated by products from the Far East. This contributes to the allegations of dumping and the adverse effect on U.S. manufacturers.

By not allowing the RHCs to support U.S. entrepreneurial companies and to have them invest overseas permits the ease of entry of foreign companies to sell in the U.S. and not vice versa.

4.5.2 INTEREXCHANGE CARRIERS (IXCs)

With deregulation of the long distance telephone business the U.S. has fostered over 300 national and regional independent long distance or interexchange carrier companies. However only three have emerged as dominant national carriers, ATT, MCI and U.S. Sprint. Of these only ATT is a major manufacturer. MCI is not in the interconnect or customer premise equipment business. It is not likely that these companies will be interested in supporting, though strategic partnerships, the U.S. telecommunications entrepreneur with the exception of ATT. Other IXCz such as Telesphere are still struggling and trying to survive through mergers with other small IXCs. In most cases the smaller companies purchase bulk transmission from the three majors and have limited plant of their own.

4.5.3 CELLULAR TELEPHONE

The cellular telephone and network business is another major battle ground. The RHCs are moving into this area rapidly on a national basis. This could be a lucrative area for the telecommunications start-up, however again, the RHCs are limited by the R&D and manufacturing regulations. Thus a large percentage of the equipment they purchase is basically standard product, a large percentage of which comes from off-shore.

4.5 THE CHALLENGES OF SELLING TO THE PTC COUNTRIES

The complaint that many customers in the PTC countries have is that technology and products available in North America are not available to them. There are numerous reasons for this situation, not the least of which is non-tariff trade barriers put in place to protect the local manufacturers. Another major factor is the lack of coordination between the U.S. government and the small telecommunications companies to address foreign markets.

4.5.1 DIFFERENT MARKETS

What applies to the U.S. may not apply to many of the Pacific Hemisphere countries. The small company has little or no knowledge of the market environment of other countries. In particular, specifics concerning regulations, standards, language, and market requirements. If the small company wants to enter the Pacific market the key is prioritization by country and by product.

4.6.2 AGENTS AND DISTRIBUTORS

When the target country is identified the most important factor is to establish a representation in that country. The most common practice is form a business relationship with an agent and/or distributor. The challenge is to find a partner that has the ability to fulfill all the entrepreneur's needs and in particular to sell, ship and support the products. It is important to understand the laws pertaining to contractual relationships in the countries before signing with an agent/distributor. Cancellation of contracts can become extremely costly.

4.6.2 ORGANIZATIONAL SUPPORT

There are a number of national and international non-profit organizations that can assist the small company. The challenge is to find them and work with them. Other sources include the Chambers of Commerce of the countries, the Embassies, and the various trade organizations.

5. RECOMMENDATION ON HOW TO ADDRESS THE CHALLENGES (9)

5.1 PREDATORY PRACTICES OF LARGE DOMESTIC AND INTERNATIONAL COMPANIES

There are a number of steps that can be taken to address the predatory practices of large companies and to effectively compete with them.

5.1.2 FORM A LOOSE CONSORTIA

The small telecommunications companies can form a loose consortia to operate functionally as divisions do in a large corporation. A major goal would be to do business with each other. This type of arrangement would also allow for the pooling of resources to compete effectively with the large entities.

5.1.3 CENTRALIZED LEGAL ASSISTANCE

Create a mechanism through existing trade organizations or through the new consortia to employ legal counsel. The purpose of the counsel is to protect patents and know how, the filing of patents, the development of contracts and most of all to challenge the large entities in the courts when necessary. Another benefit would be the capability to understand the legal environment of the Pacific Hemisphere countries and the EEC.

5.1.4 TRADE AND PROFESSIONAL ORGANIZATIONS AWARENESS

The PTC and the American Electronics Association are examples of non-profit organizations that can assist the small companies. The entrepreneur can work within the framework of these organizations to heighten the awareness of their needs to government and international bodies. They can help these organizations in putting programs in place and to enhance existing programs to assist the entrepreneurs in combining efforts to meet the challenges. These organizations can also help in making their large entity members aware of possible entrepreneurial suppliers and strategic partners.

5.1.5 TARGET PREDATORS

Through consortia and trade organizations together with joint legal counsel target one or two predators. Concentrate all legal actions and follow up support programs with a coordinated effort of companies and organizations focused on the target predators. Insure the awareness of governments and the media. Prior to initiating such action insure that there is a high probability of success.

5.1.6 POSITION PAPERS AND REPRESENTATION

The small companies should work together and through professional trade associations to develop positions on telecommunications policy, regulations and standards. Through joint financing they can find one or more representatives to participate in national and international working groups and forums. Organizations such as the PTC and AEA can become a catalyst for such activities.

5.2 THE FAR EAST CHALLENGE

The key to the Far East challenge is Japan. Just recently a number of articles have been written in regard to Mr. Morita and Mr. Ishihara's book, "The Japan That can Say No". In addition the AEA has issued a position paper entitled, "America's Future At Stake: Winning in the Global Marketplace". The following sections cover such examples, challenges and threats, with recommendations from business articles and AEA documentation.

5.2.1 "THE JAPAN THAT CAN SAY NO" (10) (11)

Dr. Lawrence Summer of Harvard University wrote an article for the New York Sunday Times December 3, 1989 entitled, "What to do when Japan says No". In that article he cites threats to the U.S. concerning both chip technology and financial dependency on Japan. Both areas of which are necessary for the telecommunications entrepreneur to succeed. Dr. Summer recommends the following steps to counter the threats posed in Messrs. Morita and Ishihara's book:

1. We must start investing in America both financially and educationally.
2. The U.S. needs to think seriously about the composition of American production. Americans should be debating not whether, but how to restore their pre-eminence in the "ace card" semiconductor industry.
3. The U.S. needs to carefully consider its approach to the newly industrialized economies of Asia.

5.2.2 THE AMERICAN ELECTRONICS ASSOCIATION RECOMMENDATIONS (12)

The AEA cites that the electronics industry is the nations largest manufacturing industry, a sub-set of which is telecommunications. Over 2.6 million workers are directly employed which is more than three times the size of the auto industry.

The electronics industry is likened to a food chain by the AEA. The survival of each unit in the chain - materials, manufacturing equipment, semiconductors, circuit boards, computer systems, networks, and software - is critical to all of the other elements in the chain.

The warning signs of loss of competitiveness in key technology product sectors and the eroding electronics trade balance with Japan are identified by the AEA. Based on this the AEA has identified the following threats:

1.The new realities of the Global Marketplace. Although small entrepreneurial enterprises and innovative products are still necessary for economic growth, they are no longer sufficient because they do not provide the critical mass to compete in the world markets.

2.The erosion of U.S. financial leadership. It is the interplay between the federal deficit and low savings rate that has forced up capital costs in the U.S. and has forced reliance upon foreign capital.

3.The decline of education. The deterioration of capabilities in math and science at all levels poses a fundamental threat to the ability of the nation to compete.

Some of the AEA recommendations to address these threats are:

1.Establish industry goals for market share, standard of living and manufacturing base.

2.Encourage cooperative efforts among U.S. companies in different industry segments.

3.U.S. companies must make a commitment to customers, manufacturing prowess, long term goals and people and to work with government to forge effective science and technology policies.

4.The U.S. Government must make a commitment to a strategic and global approach to trade, reduce the cost of capital, investments in human capital and work closely with state governments on innovative solutions.

5.2.3 ADDITIONAL RECOMMENDATIONS (13)

The following are additional recommendations to deal with the challenge of the Far East.

1.Develop educational courses through domestic and international trade associations concerning the patents and know-how practices of the Far Eastern countries.

2.Increase the Customs and Trade departments ability to focus on patent infringements.

3.Allow for the active role of the U.S. Government in the support of competitive bids by U.S. consortia.

4.Establish agencies in the Far East to represent groups of high-tech telecommunications companies.

5.3 THE EEC CHALLENGE

The recommendations to take on the EEC challenge are summarized in this section.

For the entrepreneur to survive he must form alliances with older established non-predatory telecommunications companies or with newer entities that are expanding rapidly into the European and U.S. markets.

In order to penetrate the EEC the use of country oriented marketing and public relations techniques must be used.

There is a need for the establishment of state and local organizations that can keep up to date databases on EEC telecommunications regulations, standards and practices. Included should be data on laws and available agencies/distributors.

A process should be developed through such organizations as the PTC and AEA to educate the telecom multinationals as to the availability of technology and products from the telecom entrepreneur.

The entrepreneur should support the U.S. trade policy and identify unfair telecommunications trade practices to governments and trade organizations.

5.4 THE FINANCIAL CHALLENGE

The following is a list of recommendations:

1. Change the overall short term measurement system by financial institutions, venture capitalists and stockholders.

2. Establish tax laws that encourage long term investments.

3. De-emphasize quarterly reports.

4. Establish hi-tech telecommunications funds by the venture capital/pension arms of the telecom multinationals.

5. Set up networks through organizations such as the PTC and AEA for a financial match making process between companies.

6. The education of banks as to telecom and hi-tech and the needs for knowledgeable people who understand assets in terms of patents, know how, contracts etc.

5.5 WHAT IS REQUIRED FOR CONTINUED DEREGULATION

The following are recommendations concerning deregulation in the U.S. and are understood to be potentially controversial. The important point is that deregulation should be considered in global terms.

The RHCs, at a minimum, should be allowed to have minority shares in U.S. entrepreneurial telecom manufacturing companies for their domestic and international markets.

The RHCs should be allowed to provide information processing services. They also should be allowed to become Interlata long distance telephone companies.

The interexchange carriers should be given incentives to manufacture and to be systems integrators. They should be encouraged to provide industry oriented by-pass services.

Just as the RHCs support and use the services of Bellcore, an active system could be set up for Bellcore to use the R & D services of entrepreneurs and for the RHCs to use such services directly.

Ultimately the RHCs should have the ability to perform their own R & D and to manufacture. This could be augmented by major investments and alliances with entrepreneurial companies.

5.6 HOW TO SELL TO PTC COUNTRIES (16)

Please refer to the author's paper entitled "Marketing Your Products in Asia, the Pacific Rim and Latin America" appearing in these proceedings.

The following is a brief summary of the recommendations in that paper:

Establish a method to identify specific markets.

Develop products to meet those markets.

Identify country agents for telecom products.

Work through embassies and government channels.

Obtain an international bank with locations in target countries.

Obtain support from national and international trade organizations.

The development of an international marketing plan.

6. CONCLUSION

It is not easy for the telecommunications entrepreneur to be successful; he cannot do it alone. He needs the support of other telecommunications and electronics companies, governments and industry associations. A key is the formation of telecom entrepreneurial with the support of the large telecom multinationals.

It is recommended that the PTC set up a task force to study the entrepreneurial needs with the goal to have a formal committee which will service the telecom entrepreneur.

The committee could be the catalyst for strategic alliances and for the funding of such alliances through the PTC membership.

It is recommended that the PTC work with other groups such as the AEA and the equivalent industry groups in other countries to enable the telecom entrepreneurs to make their products and services available to the countries encompassed by the PTC.

Within this difficult environment a number of entrepreneurs have succeeded. Their experiences should be used to assist others in achieving their goals.

If only a few of the recommendations listed are implemented they would increase the chances for the entrepreneur's success.

Even with the challenges and without implementation of any of the recommendations the U.S. entrepreneurial spirit will continue and find ways to confront the challenge.

It is hoped that this paper has given the entrepreneur a base to take on the challenges.

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Session 1.3

Financing Telecommunications Development in the Pacific Region

Chair:	Paul H. Vishny, D'Ancona & Pflaum, USA
Panel:	S. Abdulrachman, Posts & Telecommunications, Indonesia Bjorn Wellenius, World Bank Eugene K. Larson, Export-Import Bank Travis Marshall, Motorola

NOTES

Session 1.4

High Definition Television

NOTES

First International HDTV Digital Transmission
via INTELSAT Satellite

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(4) INTELSAT, Washington DC, USA

In this paper, the configuration and transmission performance of the transpacific HDTV field trial are described in detail. This field trial was a joint project of COMSAT, INTELSAT, AT&T and KDD using advanced digital systems, 120/140 Mbps digital codecs, the 140 Mbps COPSK modem and transportable earth stations. From the results of obtained, we conclude that an end-to-end international digital transmission of HDTV programs is commercially viable using these advanced digital systems.

1. INTRODUCTION

High Definition TV (HDTV), which gives vivid and realistic images on a large screen, is expected to be a new visual communication service for the next generation. It, however, requires more than 5 times the signal bandwidth of conventional broadcast TV and must be compressed for transmission over satellite, in this instance to use the full RF bandwidth of 72 MHz transponder on INTELSAT satellite.

Taking this background into consideration, we carried out transpacific digital HDTV field trails in April and June 1989 under a joint project among COMSAT, INTELSAT, AT&T and KDD.

The objective of the field trial was to verify the digital transmission performance of an HDTV signal over an actual satellite link using various earth station configurations. Two new advanced digital technologies were applied in the field trail, i.e., a 120/140 Mbps high efficiency digital coding system (codec) developed by KDD(1) and a 140 Mbps coded octal phase shift keying (COPSK) modem developed by COMSAT Laboratories. A conventioanl 120 Mbps modem was also used for comparison purposes.

In addition to these new digital transmission systems, AT&T provided an INTELSAT standard A earth station on the U.S. west coast and its support personnel. INTELSAT provided free use of a space segment on an INTELSAT V Pacific ocean satellite at 174°E.

A remarkable feature of the field trial configuration was the use of a small transportable earth station in Japan to investigate the possibility of an end-to-end HDTV satellite relay for commercical application, wherein HDTV programs can be directly transmitted from the place of event to a theater.

In this paper, the configuration of the field trial and the equipments and facilities used are first explained. Especially, the configuration of 120/140 Mbps HDTV codec and its basic coding performance as well as transmission error effects are presented in detail. And then, details of field test results are described to verify the possibility of HDTV transmission via satellite under various transmission configurations.

2. EXPERIMENTAL SATELLITE TRANSMISSION SYSTEM

2.1 SYSTEM CONFIGURATIONS

The transmission tests were carried out in two phases.

The Phase 1 test was held in April 1989. The objective of Phase 1 was to investiagte the transmission performance in 2 modes, viz:

① One-way transmission from the USA (C-band) to Japan (Ku-band) in the cross-strap mode operation; and
② Satellite loopback transmission in the USA (C-band)

On the USA side, INTELSAT standard-A tests were carried out at AT&T's Triunfo Pass earth station in the suburbs of Los Angeles. Installed at the earth station were 120/140 Mbps HDTV encoder/decoder (HDTV CODEC) and 140 Mbps coded octal phase shift keying modem (COPSK MODEM) with an HDTV VDR, VTR and camera as input devices.

In addition, an HDTV studio was set up temporarily in the AT&T earth station in order to transmit live HDTV demonstrations to Japan.

On the Japan side, at KDD's head office in Tokyo, a transportable earth station (INTELSAT standard E-1 class station) was set up temporarily in front of the KDD building, and a back-up was provided by an INTELSAT standard E-2 class earth station installed permanently in front of the KDD building.

In addition, a 120/140 Mbps HDTV codec, 140 Mbps COPSK modem, an HDTV VTR, and a 70-inch HDTV screen were installed. After completion of the Phase 1 test, Phase 2 was carried out in June 1989, based on the set-up as shown in Figure 1.

The objective of Phase 2 was to investigate the transmission performance in 2 additional modes, viz:

① Both-way simultaneous transmission between the USA (C-band) and Japan (Ku-band); and
② Satellite loopback transmission at Japan side (Ku-band).

In Phase 2, a 120 Mbps QPSK modem which meets INTELSAT TDMA/DSI system specifications was also used in addition to the 140 Mbps COPSK modem. Hence, performance at two digitial transmission rates could be tested viz: 120 Mbps and 140 Mbps.

As in Phase 1, the test room used on the USA side for Phase 2 was in the AT&T triunfo pass station. The place for testing on the Japan side was moved to KDD R and D Laboratories outside Tokyo. The transportable earth station was set up in front of the laboratories, and the E-1 earth station installed permanently on the roof of the laboratories was also used.

Table 1 shows the majore system parameters of the earth stations used.

2.2 EQUIPMENT AND FACILITIES USED

2.2.1 120/140 Mbps Compact HDTV Codec

A block diagram of the codec is shown in Figure 2 and its principal system parameters are listed in Table 2. The input 1125/60 HDTV signal, which consists of a luminance component (Y) and two color components (P_R, P_B), are sampled at a frequency of 48.6 MHz, 16.2 MHz and 16.2 MHz, respectively, and each component is digitized into an 8 bit PCM signal. In order to reduce the amount of source information as much as possible, all the samples in the horizontal and the vertical blanking periods are removed, and line-alternative processing is applied to both color components as pre-processing. In this processing, the samples of P_R and P_B components are transmitted alternately every two lines (P_R; odd lines, P_B; even lines). By this preprocessing, the total number of picture elements to be coded is reduced to 1680 pels/line (1260 for Y, 420 for P_R or P_B).

Source information to be transmitted is then reduced to 1/4 by 1/2 sub-sampling and 4 bit/pel DPCM coding as described below.

① 1/2 Sub-sampling

A line-quinqunx structure where the sampling point is moved from line to line is employed as a 1/2 sub-sampling structure. A significant advantage of this structure is that as filtering does not extend to the temporal direction, there is no difference in deterioration of picture quality between still and moving pictures, and, hence, the resulting picture gives a stable high resolution.

② Intrafield DPCM with an adaptive noise shaping filter and an adaptive quantizer

A DPCM system normally consists of a feedback loop, and its time delay is an important factor in determining the amount of hardware.

TABLE 1 SPECIFICATION OF EARTH STATIONS USED

Earth station		AT&T Triunfo Pass No.2 (TRI Station)	KDD Transportable [Transportable station "Big Shell"]	KDD Kamifukuoka Experimental E-1 (Experimental E-1 Station)	KDD Tokyo No.2 (Tokyo HS Station)
INTELSAT Standard Class		A	E 1	E 1	E 2
INTELSAT earth station code		TRI-2A	KTP-1E	SHJ-1R	TKY-2E
Antenna	Diameter(m)	30	2.6	3.3	5.6
	Type	Cassegrain	Off-set Gregorian	Off-set Gregorian	Off-set Gregorian
Maximum EIRP		85.7	72.2	73.3	——
System G/T (dB/K)		38.3	27.0	26.6	33.0
Frequency		C	Ku	Ku	Ku
HPA		3kW-KLY	600W (two 300W-TWTA)	300W-TWTA	——
location		Los Angeles	Tokyo and Saitama	Saitama	Tokyo

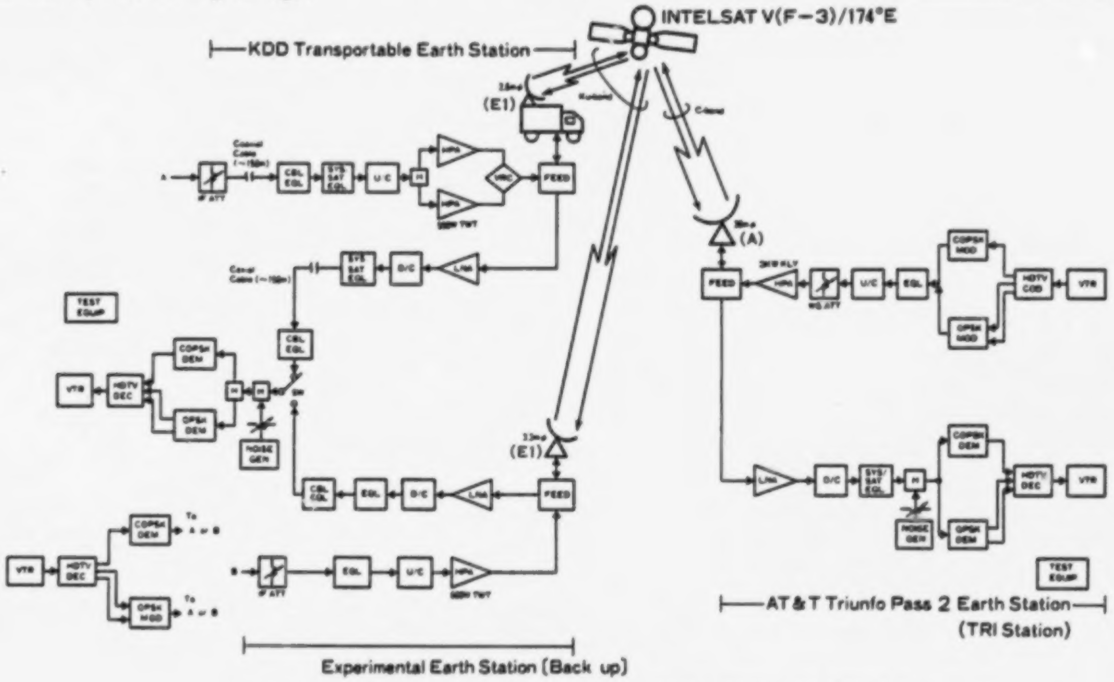

INTELSAT V(F-3)/174°E
KDD Transportable Earth Station
(E1)
Ku-band
C-band
IF ATT
Coaxial Cable (~150m)
CBL EQL
SYS SAT EQL
U/C
H
HPA
HPA
300W TWT
HYB
FEED
D/C
LNA
TEST EQUIP
COPSK DEM
OPSK DEM
VTR
HDTV DEC
NOISE GEN
SW
(E1)
EQL
COPSK DEM
OPSK MOD
To A or B
(A)
3kW KLY
HPA
IF ATT
U/C
EQL
COPSK MOD
OPSK MOD
HDTV COD
VTR
LNA
D/C
SYS/SAT EQL
H
NOISE GEN
COPSK DEM
OPSK DEM
HDTV DEC
VTR
TEST EQUIP
AT&T Triunfo Pass 2 Earth Station
(TRI Station)
Experimental Earth Station (Back up)

FIG.1 CONFIGURATION OF TRANSPACIFIC FIELD TRIAL IN PHASE 2

From the standpoint of compact hardware implementation, one dimensional intrafield prediction, which is the simplest prediction method, is employed.

This intrafield prediction with a 4 bit quantizer sometimes results in coding noise such as granular noise for small prediction errors as well as slope overload and edge busyness for large prediction errors. To cope with this coding noise, the present codec employs two counter-measures for DPCM coding, i.e. an adaptive noise shaping filter and an adaptive quantizer, which do not require any significant hardware increase.

The adaptive noise shaping filter is especially effective in reducing the granular noise by shaping the frequency characteristics of the coding noise to fit human visual perception.

On the other hand, the adaptive quantizer is very effective in reducing slope overload and edge busyness by assigning 16 quantization level , not to 511 levels at all times as in a conventional quantization, but to 256 levels in an adaptive quantization.

After the DPCM coding, HDTV signals are multiplexed with 4 channels of audio signals, which are sampled at a frequency of 48 KHz with 16 bits/sample AD/DA precision. The resultant bit rate assigned to these audio signals is 3.072 Mbps.

For protection against transmission errors, doubly encoded Reed-Solomon (RS) codes are employed as forward error correction (FEC) codes. In these FEC codes, a picture field is divided into three parts in the horizontal direction and into five parts in the vertical direction, and RS (156, 152) and RS (210, 207) are applied to the horizontal and vertical directions, respectively. The assigned bit rate is 4.660 Mbps.

By means of these FEC codes, it is possible to correct maximum burst errors of one line as well as random errors with a small redundancy of 4.1%. For example, a BER (bit error rate) of 3×10^{-4} or 10^{-6} is corrected to 5×10^{-7} or 10^{-13} for random errors, respectively. Even if such transmission errors could not be corrected, the picture quality deterioration is not so significant because the intrafield prediction used propagates errors only in the horizontal direction. Such picture quality deterioration, moreover, is made invisible to some extent by error concealment processing where a degraded line is interpolated with adjacent undegraded lines at the receiver side. The present codec is therefore very robust to transmission errors.

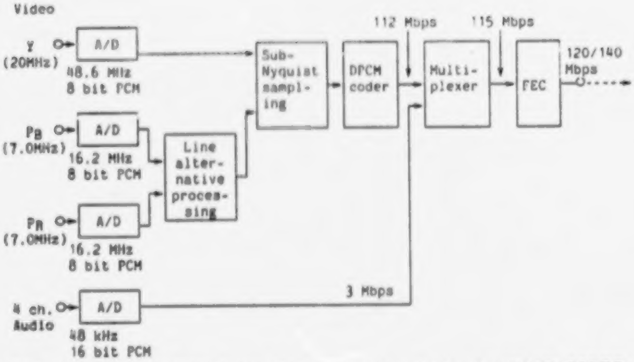


FIG.2 BLOCK DIAGRAM OF THE 120/140 MBPS COMPACT CODEC

TABLE 2 PRINCIPAL SYSTEM PARAMETERS

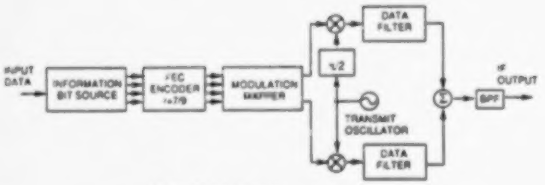
Input Video	Y (20 MHz bandwidth) P_R (7.0 MHz) P_B (7.0 MHz)
A/D, D/A Converter sampling frequency quantizer precision	48.6 MHz for Y component 16.2 MHz for P_R component 16.2 MHz for P_B component 8 bit PCM
Pre-processing	removal of all horizontal and vertical blanking interval signals
	line alternative processing for P_R and P_B components
Bit-reduction coding	1/2 sub-Nyquist sampling with a line offset structure
	one dimesnional intrafiled prediction with an adaptive noise shpaing filter
	Adaptive quantization with 4 bit fixed length codes
Sound signals	4 channels with 16 bit PCM of 48 kHz sampling
Forward error correction	Reed Solomon code
Scrambling	8 stage pseudo random pulse generator
Transmission rate	120 Mbps/140 Mbps (switchable)
Hardware specification power outside view weight	AC 100/200 V.50/60 Hz 430(W) x 600(D) x 300(H) (mm) about 37 kg

2.2.2 PSK Modem

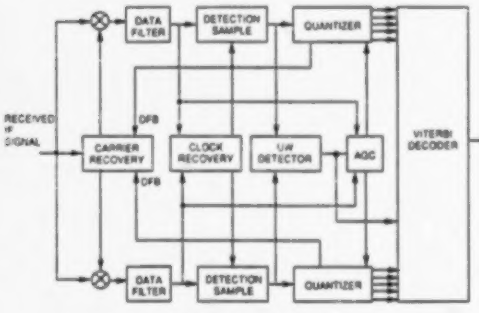
(1) 140 Mbps COPSK modem

This modem was developed for transmitting 140 Mbps of information via a full 72 MHz tranponder on INTELSAT satellites. This system was designed by COMSAT laboratories for the purpose of wideband data transmission and restoration of under sea optical fiber cable.

Figure 3 shows the block diagram of the 140 Mbps modem. The transmitting/receiving filter has characteristics of $\sqrt{40\%}$, COR and BT=1.0 (B: filter band width, T: symbol period), which equally divides a 40% cosine-roll-off Nyquist filter (40%, COR) employed in the INTELSAT/TDMA system. In addition, an aperture equalizer is added on the transmitter side. The COPSK modem, for which input/output baseband data is serial, consists of a quadrature modulator and a quadrature detector. The demodulator employs an AFC (Automatic Frequency Control Circuit) and AGC (Automatic Gain Control Circuit) for compensating fluctuation of received frequency and received level. The carrier reconstruction is performed by the DDF (Decision Directed Feedback) method, and the clock reconstruction is carried out by a squaring circuit as in the INTELSAT TDMA/QPSK system. Viterbi decoding using a convolutional code with 7/9 coded efficiency is employed as an error correction code. The modem can transmit a total data at 180 Mbps including information at 140 Mbps.



(a) modulator/encoder



(b) demodulator/decoder

FIG.3 BLOCK DIAGRAM OF 140 MBPS COPSK MODEM

(2) 120 Mbps QPSK modem

This modem used in Phase 2 is based on the specification of the INTELSAT TDMA/DSI system. Two channells of 60 Mbps are input or output in parallel in the system. Carrier reconstruction in the demodulator is performed by a 4x multiplexer circuit which produces phase-ambiguity every π/2 phase. Hence, in the field trial, differential coding was employed for deciding the phase of the reconstructed carrier signal.

3. BASIC CODEC PERFORMANCE

3.1 BASIC QUALITY

HDTV moving test pictures were used to assess the coded picture quality and to investigate the signal to noise ratio. These test pictures were recorded on a 1-in VTR (Sony HDV 1000) and included various types of pictures, from still to rapidly moving, with differing conditions of brightness, color, contrast and texture.

From the test(1), it can be confirmed that S/N of 40.4-43.3 dB (unweighted) and 49.9-52.8 dB (weighted) are obtained. In addition, the adaptive noise shaping filter provides an improvement of S/N with about 2.5 dB.

Regarding picture quality deterioration, some slight granular noise and edge busyness were observed for such critical pictures as flat parts with saturated colors or steep edges. Moreover, some resolution loss due to sub-sampling was observed for pictures with detailed textures.

3.2 CHANNEL ERROR EFFECT

A subjective picture quality evaluation test based on a 5-point impairment scale was carried out on the coded pictures under various channel error rates.

Figure 4 shows the evaluation result

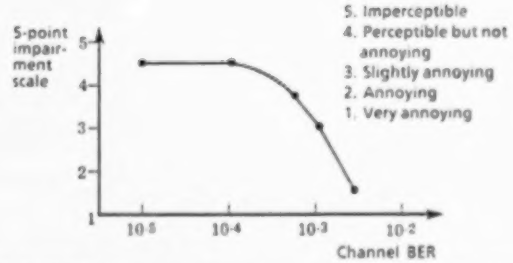


FIG.4 SUBJECTIVE PICTURE QUALITY EVALUATION RESULTS

obtained by 20 non-expert viewers at a observation distance of 3H from a 30 inch CRT monitor (H = picture height). The following was deduced from the results.

At a BER lower than 1×10^{-4}, the assessed value for the picture quality is more than 4.6, and the influence of transmission errors is completely imperceptible. The impairment of pictures due to transmission errors begins to be perceptible at a BER of approximately 1×10^{-4}. In the case of a BER greater than 1×10^{-4}, degradation due to transmission error propagates in a horizontal direction at a maximum length of 1/3 scanning line because one dimensional intrafield prediction and triple parallel processing are used.

From these results, we can say that this system is extremely robust to transmission error due to the use of simple DPCM coding with strong FEC coding. Further, it was found that the threshold BER at which the influence of transmissoin error can begin to be compeltely ignored is approximately 1×10^{-4}.

4. FIELD TRIAL

4.1 LINK BUDGETS CALCULATED

Prior to an actual field trial, a link budget calculations were carried out in order to make the possibility clear theoretically. In this calculations, the following considerations and assumptions were made:

① Assuming fine weather conditions, rain attenuation on the up-link and down-link, and deterioration of earth station G/T due to rain on the down-link, may be ignored.

② The specified INTELSAT value for interference on the same channel due to re-use of frequencies on the up-link and down-link is assumed.

③ The satellite input back-off is assumed to be 3.0 dB in Phase 1 and the transmission e.i.r.p of the KDD transportable earth station to be 12.2 dB in Phase 2.

Table 3 shows the link budgets calculated for each test configulations in Phase 1 and Phase 2 in case of the 140 Mbps HDTV digital transmission.

In case of 120 Mbps transmission, the value of Eb/No (energy per bit to noise power density ratio) in item D-4 of Table 3 is improved by about 0.6dB.

The values in parentheses of Item D-3 mean C/N values which were obtained in the actual

TABLE 3 LINK BUDGET

	PHASE 1			PHASE 2		
	TRI-2A−TRI-2A (30m−30m)	TRI-2A−KTP-1E (30m−2.6m)	TRI-2A−TKY-2E (30m−5.5m)	KTP-1E−KTP-1E (2.6m−2.6m)	KTP-1E−TRI-2A (2.6m−30m)	
A. UPLINK C/T CALCULATION (Earth Station Code and Link)						
0. Transponder connectivity	23(EH)/23(EH)	23(EH)/63(WS)	23(EH)/63(WS)	63(WS)/63(WS)	63(WS)/23(EH)	
1. Earth station transmit e.i.r.p.	85.7	85.7	85.7	72.2	72.2	dBW
2. Uplink path loss	−200.6	−200.6	−200.6	−207.5	−207.5	dB
3. Gain of 1㎡ antenna	37.2	37.2	37.2	44.5	44.5	dBi/㎡
4. Uplink tracking error	−0.3	−0.3	−0.3	−0.5	−0.5	dB
5. Carrier power flux density arriving at satellite (1+2+3+4)	−78.0	−78.0	−78.0	−91.3	−91.3	dBW/㎡
6. Transponder saturation flux density at beam edge	−72.0	−72.0	−72.0	−80.3	−80.3	dBW/㎡
7. Uplink pattern advantage	3.0	3.0	3.0	3.0	3.0	dB
8. Transponder saturation flux density toward earth station (6−7)	−75.0	−75.0	−75.0	−83.3	−83.3	dBW/㎡
9. Carrier input backoff (6−8)	−3.0	−3.0	−3.0	−8.0	−8.0	dB
10. Satellite G/T at beam edge	−11.6	−[illegible]	−11.6	3.3	3.3	dB/K
11. C/T Thermal (6−9+10−3)	−123.8	−123.8	−123.8	−129.5	−129.5	dBW/K
12. C/I Co-Channel Interference	−122.6	−122.6	−122.6	—	—	dBW/K
13. C/T - Uplink	−126.3	−126.3	−126.3	−129.5	−129.5	dBW/K
B. INTERMODULATION C/T	None	None	None	None	None	dBW/K
C. DOWNLINK C/T CALCULATION						
1. Transponder saturation e.i.r.p. at beam edge	29.0	44.4	44.4	44.4	29.0	dBW
2. Carrier output backoff	−0.5	−0.5	−0.5	−3.5	−3.0	dB
3. Downlink pattern advantage	3.0	3.5	3.5	3.5	3.0	dB
4. Downlink path loss	−196.4	−205.3	−206.3	−205.3	−196.4	dB
5. Downlink tracking error	−0.3	−0.5	−0.3	−0.5	−0.3	dB
6. Earth station G/T	38.3	27.0	33.0	27.0	38.3	dB/K
7. C/T Thermal	−126.9	−131.4	−125.2	−134.4	−129.4	dBW/K
8. C/I Co-Channel Interference	−117.5	—	—	—	−120.0	dBW/K
9. C/T - Downlink	−127.4	−131.4	−125.2	−134.4	−129.9	dBW/K
D. TOTAL C/N, Eb/No						
1. C/T total - Thermal and Interference	−129.9	−132.6	−128.8	−135.6	−132.7	dBW/K
2. Receiver noise bandwidth (10log 60 MHz)	77.8	77.8	77.8	77.8	77.8	dB-Hz
3. C/N total - Thermal and Interference	20.9 (25.8)	18.2 (18.6)	22.0 (25.6)	15.2 (17.0)	18.1 (21.0)	dB
4. Eb/No (information rate : 139.264 Mbps)	17.2	14.5	18.3	11.5	14.4	dB
E. MARGIN						
1. Eb/No at threshold BER (1×10^{-4})	10.0	10.0	10.0	10.0	10.0	dB
2. Margin	7.2	4.5	8.3	1.5	4.4	dB

satellite link. The slight difference of these values in the case of large C/N may be ascribed mainly to the fact that measured C/N includes the supression effect of uplink noise due to nonlinearity of TWTA, but in almost cases, comparing these values, fairly good agreement is obtained for all satellite configurations under fine weather conditions.

These results show that an operational margin of 7.2 dB and 4.5 dB were obtained for the transmission cases of the USA to Japan and of satellite loopback on the USA side in Phase 1, respectively. In Phase 2, an operational margin of 4.4 dB and 1.5 dB were obtained from Japan to USA and in satellite loopback on the Japan side, respectively.

From these results, it is therefore clear that HDTV transmissions are theoretically quite feasible.

4.2 TRANSMISSION PERFORMANCE

4.2.1 Satellite Loopback Tests

Prior to satellite loopback tests, we examined the C/N required to obtain a BER of 10^{-4}, which is the threshold BER for the HDTV codec in an IF loopback. As a result, 12.2 dB and 12.6 dB were necessary for the 140 Mbps COPSK modem and the 120 Mbps PSK modem, respectively. The power transfer characteristics of the HPA in each up-link were then measured with the HPA terminated in a dummy load. From this measurement, the satellite TWTA turned out to be activated almost in the linear region with an HPA output power back-off of about 9 dB in the satellite loopback test and of about 10 dB in the transpacific test, respectively, at the TRI earth station, because it was quite sufficient to operate the TWTA near the point of saturation.

At the transportable earth station, on the other hand, there was not so much leeway in the e.i.r.p., so that the operating point of the HPA was restricted by the OBE (out of band emission) due to the spectrum spreading of the PSK carrier. In order to make the OBE meet the requirement of INTELSAT TDMA/DSI system specifications; the output back-off had to be no less than 4.5 dB. In the actual satellite tests, therefore, the maximum operating point was set at an output back-off of 5 dB. And the maximum e.i.r.p. of the transportable earth station and the experimental E-1 earth station were set at 72.2 dBW and 73.3 dBW, respectively.

Figures 5-1 and 5-2 show the e.i.r.p. vs received C/N characteristics at the TRI earth station and at the Ku-band small earth station in Japan, respectively. As shown in these figures at the TRI earth station, a high C/N of 27 dB was obtained at 86 dBW e.i.r.p. which corresponded to a satellite TWTA input back-off of about 2 dB. At the Ku-band small earth station, on the other hand, the C/N was of the order 17 ~ 18 dB even for the maximum e.i.r.p. of 73.3 dB.

As these C/N do not contain the up-link noise suppression effect due to non-linearity of the satellite TWTA, it is necessary to consider a further deterioration of about 1 ~ 1.5 dB for the actual satellite link. In order to determine the optimum operating point for the satellite TWTA, some noise was added to the received IF signal to obtain a BER of 10^{-6} under about 2 dB input back

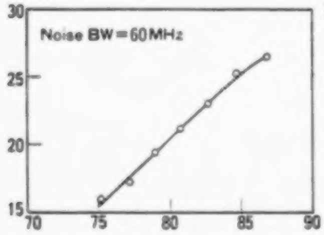


FIG.5-1 E.I.R.P. VS C/N AT TRI EARTH STATION

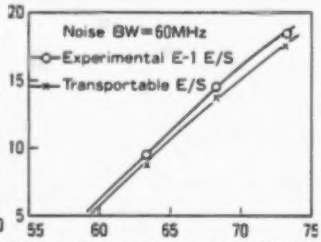


FIG.5-2 E.I.R.P. VS C/N AT KU SMALL EARTH STATIONS

off and then the e.i.r.p. of the TRI earth station was adjusted to make the BER a minimum. As a result, the optimum operating point was at 85.7 dB in e.i.r.p. and 2 dB in TWTA input back-off.

Figures 6-1 and 6-2 shows the BER performance for 140 Mbps COPSK transmission and for 120 Mbps PSK transmission, respectively, which were obtained under the above mentioned condition.

From these results, it was clear that C/N of 13.5 dB and 13 dB were necessary for 140 Mbps and 120 Mbps C band transmission, respectively, to achieve the threshold BER of 10^{-4}, and the same C/N was required at the Ku-band small earth station.

4.2.2 Transpacific Tests

In Phase 1 of the field trial between the USA and Japan, one-way transmission tests were first carried out at 140 Mbps from the TRI earth station to the transportable E-1 earth station and the E-2 earth station in Tokyo.

And in Phase 2, both way transmission tests at 120 Mbps as well as 140 Mbps were undertaken between the TRI earth station, and the transportable E-1 earth station and the experimental E-1 earth station installed outside Tokyo.

(1) One-way transmission

Figure 7 shows the measured C/N characteristics on the Japan side with variation of the e.i.r.p. of the TRI earth station. The maximum value of C/N for the received signal is obtained in the region of saturation output of the TWTA; it is 19.3 dB for the transportable E-1 earth station and 25.9 dB for the E-2 earth station, this difference of 6.3 dB being due to the difference in the G/T of the station.

After equalizing the channel characteristics and determining the optimum operating point of the satellite TWTA, the BER performance was measured by adding noise to the received IF signal. As a result, a similar performance was obtained to that achieved in the satellite loopback test at the TRI earth station shown in Figure 6-1.

The channel characteristics themselves were considered by slightly varying the delay characteristics on the receiving side to obtain the best BER performance. It was found that by inserting a parabolic delay of 3 - 4 ns, as shown in Figure 8, an improvement of approx. 1 dB in the Eb/No was obtained when the BER was 10^{-6}.

To consider the up-link margin, the BER performance measured after varying the e.i.r.p.

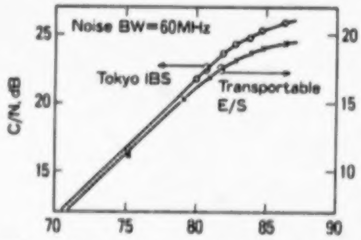


FIG.7 E.I.R.P. VS C/N FROM TRI EARTH STATION TO KU SMALL EARTH STATIONS

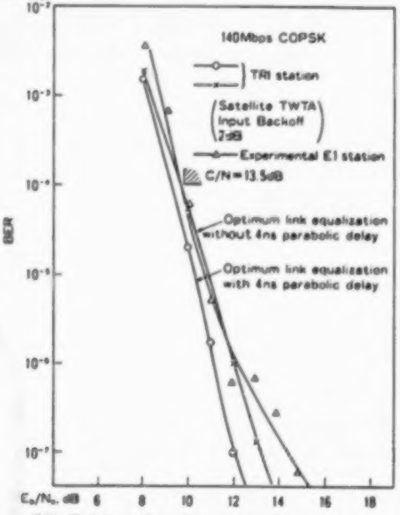


FIG.6-1 C/N VS BER AT SATELLITE LOOPBACK (140 MBPS)

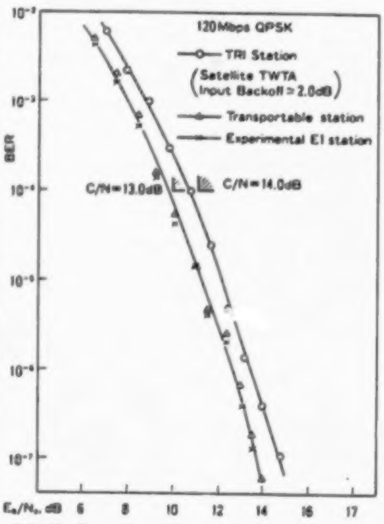


FIG.6-2 C/N VS BER AT SATELLITE LOOPBACK (120 MBPS)

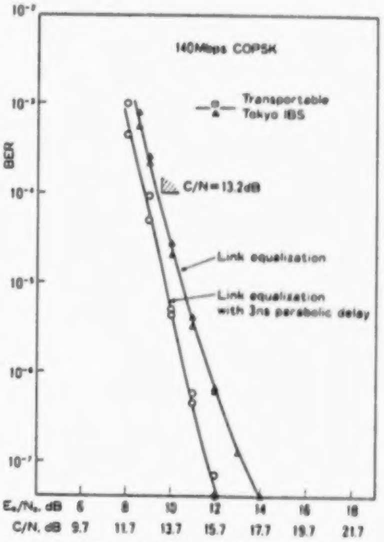


FIG.8 C/N VS BER FROM TRI EARTH STATION TO KU SMALL EARTH STATIONS (140 MBPS)

of the TRI station is shown in Figure 9. It is seen from the figure that to obtain a BER of 10^{-4}, there is an up-link margin of 5 dB or more if it was received at the transportable E-2 earth station, and of 10 dB or more if the signal was received at the E-2 earth station.

(2) Both-way Transmission Tests

Figure 10 shows the C/N characteristics of the received signal at the TRI earth station when the transmitting e.i.r.p. of the transportable earth station was varied. With the HPA of these Ku-band earth stations, however, the satellite TWTA could not be saturated

Under the condition of an input back-off of 2 dB for the satellite TWTA at the TRI earth station, the results of BER performance measured by adding noise to the received IF signal at the transportable E-1 earth station and experimental E-1 earth station, were found to be almost the same as that obtained in the one-way transmission test.

Figure 11 shows BER performance measured at the TRI earth station when the transmitting e.i.r.p. of the transportable station was varied at 140 Mbps transmission. From this figure, it is seen that the threshold e.i.r.p. to obtain the BER of 10^{-4} is about 67 dBW. Figure 12 shows measured BER performance by adding noise to the received IF signal at the TRI earth station after setting the transmitting level of the transportable earth station to the maximum e.i.r.p. of 72.2 dBW. From this figure, it is seen that threshold C/N was 14.7 dB. Also, concerning the measured BER performance transmitted from the E-1 experimental earth station to the TRI earth station, since there was a slip in the recovered carrier from the demodulator which was considered to be due to a ripple in the delay characteristics of the transmission channel, useful data could not be obtained.

The BER performance at 120 Mbps transmission was measured as a function of Eb/No. In this case, this result, however, had practically no effect on the delay characteristics of the experimental E-1 earth station.

Figures 13-1 and 13-2 show BER performance measured on each side of the Japan-USA link respectively, varying the e.i.r.p. of the TRI station, the transportable station and E-1 experimental station. Figure 14 shows the BER performance measured by adding noise to the received IF signal after setting the input back-off of about 2 dB to the satellite TWTA for TRI transmissions, and then the transmission levels of the transportable station and E-1 experimental station to their maximum e.i.r.p. of 72.1 and 73.3 dBW, respectively.

4.2.3 Summary of Results Obtained

The BER performance obtained in the satellite experiments varied depending on the operating point of the satellite and on the degree of equalization of the transmission channel. However, it was found that from the above results, the C/N to obtain the BER of 10^{-4} required for HDTV signal transmission was as follows:

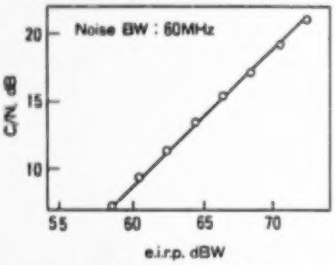


FIG.10 E.I.R.P VS C/N FROM TRANSPORTABLE EARTH STATION TO TRI EARTH STATION (120 MBPS)

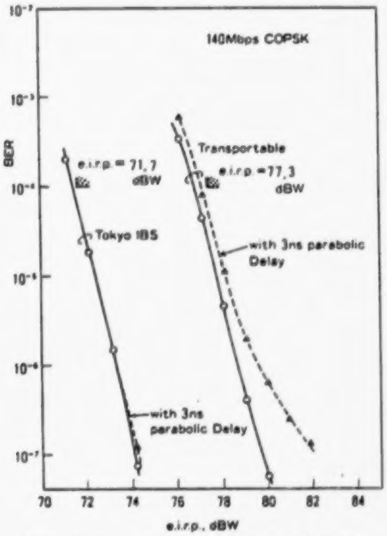


FIG.9 E.I.R.P VS BER FROM TRI EARTH STATION TO KU SMALL EARTH STATION

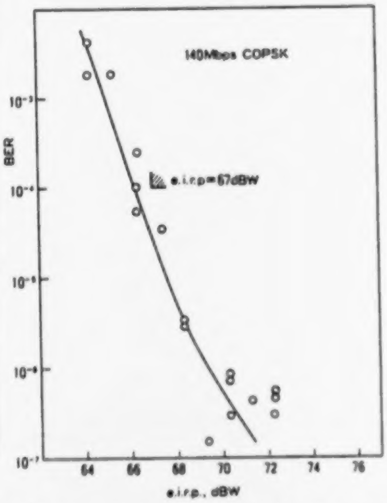


FIG.11 E.I.R.P. VS BER FROM TRANSPORTABLE EARTH STATION TO TRI EARTH STATION (140 MBPS)

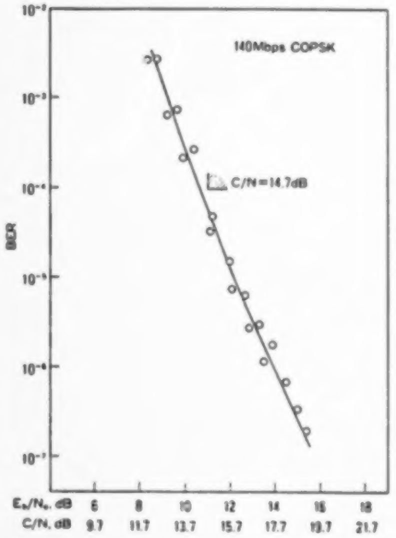


FIG.12 C/N VS BER FROM TRANSPORTABLE EARTH STATION TO TRI EARTH STATION (140 MBPS)

① In the case of 140 Mbps COPSK signal transmissions:

IF Loopback : 12.2 DB (Eb/No = 8.5 dB)
Ku-Loopback : 13.5 dB (Eb/No = 9.8 dB)
C-Ku : 13.2 dB (Eb/No = 9.5 dB)
Ku-C : 14.7 dB (Eb/No = 11.0 dB)

② In the case of 120 Mbps transmissions:

IF Loopback : 12.6 DB (Eb/No = 9.6 dB)
Ku-Loopback : 13.0 dB (Eb/No = 10.0 dB)
C-Ku : 13.0 dB (Eb/No = 10.0 dB)
Ku(E-1)-C : 14.2 dB (Eb/No = 11.2 dB)
Ku(transportable)-C: 16.5dB(Eb/No=13.5dB)

It is noted that in the case of Ku-C, the reason why the C/N obtained show more than 1 dB is considered to be due to the restricted time schedule when errors for the level fluctuation of transmitting e.i.r.p. and the fluctuation of climatic conditions could not be removed. From these results, it is concluded that the threshold C/N required to obtain the BER of 10^{-4} are 13.5 dB for 140 Mbps COPSK signal transmission, and 13.0 dB for 120 Mbps QPSK signal transmission.

Table 4 shows the maximum C/N obtained for various combinations of earth stations by using the stations G/T and e.i.r.p.. From these results, it is seen that these data give an operational margin of more than 2 dB in some cases.

TABLE 4 MAXIMUM C/N OBTAINED IN PHASE I AND II

C/N (dB)

Trans/Recv	TRI ●	TOK-IBS	BS	E-1
TRI ●	25.8(E→E)	25.8(E→W)	18.8(E→W)	—
BS	21.0(W→E)	—	17.0(W→W)	—
E-1	21.5(W→E)	—	17.2(W→W)	18.2(W→W)

● : C-band earth station

4.3 CONSIDERATION OF HDTV TRANSMISSION

In this section, we theoretically considered the future possibility of transpacific HDTV digital transmission between the USA and Japan under the various combinations of INTELSAT E-1, E-2, E-3, transportable earth station used as a small earth station and INTELSAT A as a standard earth station. This consideration leads us to investigate an appropriate transmission system of HDTV. Prior to calculation of the availability of various earth station combinations, the following assumption was made.

- Transmissions are made by a Hemi-zone beam for the C band and a spot beam for the Ku band at a bit rate of 120 Mbps. Earth stations are assumed to be located in Tokyo and in the west coast of the USA.
- The INTELSAT V satellite is used in POR. Its elevation angle from Tokyo is 30°, and from the USA is 10°.
- OBE (Out-of-Band-Emission) due to spectral spreading of PSK signals are quoted for the TDMA/DSI system. The HPA output back-off required to satisfy the INTELSAT specification is assumed to be 4 dB maximum.
- The threshold BER of the HDTV transmission is assumed to be 1×10^{-4}. Taking the two-way effect of differential encoding and absolute phase encoding into account, the C/N which gives this BER in the 60 MHz band of a 120 Mbps/QPSK modem is 13.0 dB.
- 2 dB is margined for deterioration of C/N due to mismatch of the modem, incompletion of the transmission path, nonlinearity of satellite transponders, satellite tracking error and interference from other systems in the satellite link design.
- The characteristics of earth stations to be used are shown in Table 5.
- Insofar as concerns e.i.r.p., the earth stations were assumed to have a standard antenna diameter (aperture efficiency 65%). For Ku band earth stations, the station noise temperature was assumed to be 22 dBK (the

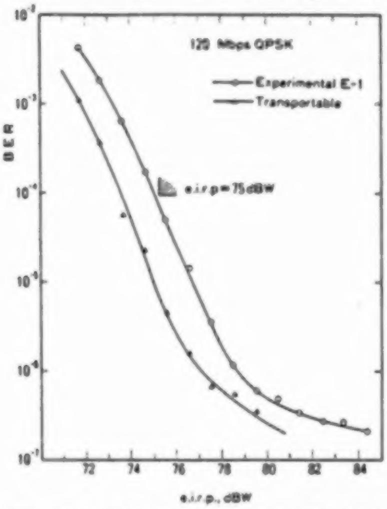


FIG.13-1 E.I.R.P. VS BER FROM TRI EARTH STATION TO KU EARTH STATIONS (120 MBPS)

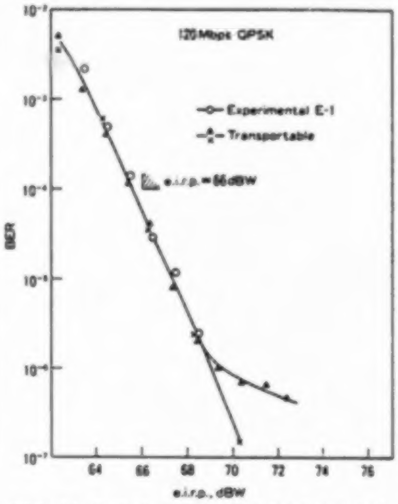


FIG.13-2 E.I.R.P. VS BER FROM KU EARTH STATIONS TO TRI EARTH STATION (120 MBPS)

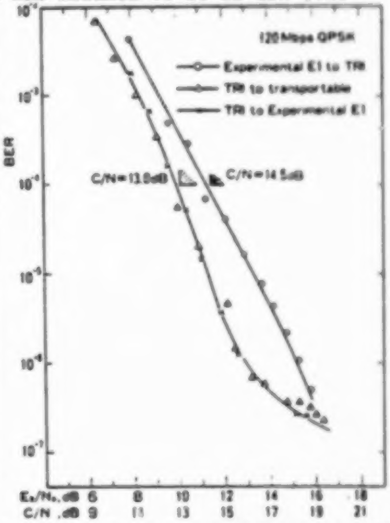


FIG.14 C/N VS BER BETWEEN TRI EARTH STATION AND KU EARTH STATIONS (120 MBPS)

transportable earth station has a capacity of 21 dBK).

Table 6 shows the total C/N and the availability for the cases of Japan to the USA and vice versa. And it should be noted that as E3 transmission characteristics are the same as those for E2, the case of E3 transmission has been omitted.

The following theoretically became clear from Table 6:

① Apart from combinations of transportable stations(Big Shell: E1 class) and E1 earth stations, HDTV transmissions have a 99% availability for nearly all other station groupings.

② For transportable station and E1 earth stations, it is desirable that the interfacing station is either E2 or E3.

③ For E2, the interfacing station must be E2 or a higher grade earth station.

TABLE 5 EARTH STATION CHARACTERISTICS CONSIDERED

Earth Station	G/T (dBK)	EIRP (dBW)	HPA Maximum Power (KW)
A(C-band)	35.0 (Te=105K)	86.4 (MAX : 92.4)	3
BS	27.0 (Te=126K)	74.0 (MAX : 78.0)	0.8
E−1	28.2 (Te=158K)	74.3 (MAX : 78.3)	0.5
E−2	32.2 (Te=156K)	77.8(WS) 81.1(ES) (MAX : 85.3)	1
E−3	35.4 (Te=158K)	77.8(WS) 81.1(ES) (MAX : 91.5)	2

TABLE 6 C/N AND AVAILABILITY

above : Japan → USA
below : USA → Japan

Trans / Recv	Std. A (C-band)	transportable (Ku-band)	Std. E-1 (Ku-band)	Std. E-2 (Ku-band)	C/N(dB) AVAILABLITY (%)
Std. A	20.4 dB 20.4 dB	18.1 dB 16.6 dB	18.3 dB 16.8 dB	20.2 dB 20.7 dB	TOTAL-C/N
(C-band)	99.99 % 99.99 %	99.85 % 99.55 %	99.87 % 99.66 %	99.97 % 99.98 %	AVAILABLITY
transportable	16.4 dB 19.4 dB	14.5 dB 15.6 dB	14.7 dB 15.6 dB	16.3 dB 19.6 dB	TOTAL-C/N
(Ku-band)	99.20 % 99.95 %	0 % 61.32 %	0 % 61.32 %	98.94 % 99.93 %	AVAILABLITY
Std. E-1	17.9 dB 20.4 dB	15.5 dB 16.6 dB	15.7 dB 16.8 dB	17.4 dB 20.7 dB	TOTAL-C/N
(Ku-band)	99.85 % 99.97 %	0 % 98.99 %	93.20 % 99.28 %	99.74 % 99.96 %	AVAILABLITY
Std. E-2	20.9 dB 23.4 dB	18.6 dB 19.4 dB	18.8 dB 19.7 dB	20.8 dB 24.1 dB	TOTAL-C/N
(Ku-band)	99.99 % 99.99 %	99.85 % 99.93 %	99.87 % 99.92 %	99.96 % 99.99 %	AVAILABLITY
Std. E-3	23.3 dB 25.2 dB	20.5 dB 21.1 dB	20.7 dB 21.4 dB	23.0 dB 26.4 dB	TOTAL-C/N
(Ku-band)	99.99 % 99.99 %	99.95 % 99.97 %	99.96 % 99.97 %	99.98 % 99.99 %	AVAILABLITY

5. CONCLUSION

We have described the experimental system, configuration and results obtained in the first digital field trial of HDTV which were carried out between Japan and the USA via an INTELSAT satellite. Based on these results, we concluded that an end-to-end HDTV digital relay using small earth stations is commercially viable.

The live demonstration from the USA side which was carried out in Phase 1 of the field trial was highly acclaimed, and confirmed that HDTV digital transmissions are quite realistic.

Following this trial, a live demonstration of HDTV was also televised in October this year (1989) from Tokyo to the SMPTE (Society of Motion Picture and Television Engineers) Conference at the Los Angeles Convention Center in the USA. A transportable earth station (E1 class: Big Shell) was used on the Tokyo side and a small earth station with a G/T of 31 dB/K°(E2 class) on the USA side, the digital transmission rate being 120 Mbps. This demonstration was also favorably acclaimed.

Due to the possibilities offered by HDTV digital transmissions as shown by this test, it is expected that international relays of sporting and entertainment events by HDTV will become more and more frequent in the future.

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HDB-MAC, A CONDITIONAL-ACCESS HDTV TRANSMISSION FORMAT

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PART 1 SYSTEM REQUIREMENTS

ABSTRACT

This paper considers the requirements for the transmission of High Definition Television Systems (HDTV). It concludes that at least 2 transmission formats will be required. The first format should be compatible with existing NTSC T.V. sets. The second format is for conditional-access applications and must not be directly compatible with existing T.V. sets. HDB-MAC is a conditional-access system designed to minimize the total cost of the consumer T.V. set, taking into account both of these requirements. The second part of this paper gives a technical description of the HDTV system transmission format.

INTRODUCTION

High Definition TV technology has gained wide acceptance as a crucial growth opportunity for the electronics industry. Predictions have been made of a multi-billion dollar market in HDTV and related products by the turn of the century. At the root of these predictions is the assumption that HDTV will become a consumer product causing the eventual displacement of the present generation of home TV receivers. These predictions may or may not be true. However, in the North America, no convincing scenario has yet been described which would lead to the rapid introduction of consumer HDTV.

The difficulties are both technical and commercial. One of these is the absence at the present time of a reasonably priced large-screen HDTV display. However, this single technical problem often masks some equally basic difficulties of a more commercial nature. For example, potential HDTV set manufacturers face a significant "chicken and egg" problem. They are unlikely to be willing to make the large investments necessary to develop a consumer receiver until they know that attractive HDTV programming will be available through a number of delivery media. Conversely, there is no incentive to broadcast HDTV programmes unless a large population of HDTV receivers has been previously deployed. Assuming that the receiver technology problems (such as display quality/cost) can be overcome, a series of commercial issues of the type just described will remain to prevent the rapid introduction of consumer HDTV.

Any transmission format for HDTV should look beyond the immediate technical problems and, wherever possible, address the commercial roadblocks which will remain. It is not suggested that all such roadblocks can be entirely eliminated through the characteristics of the transmitted signal, or that a single format can be optimum for all media or all applications. However, it is possible to identify some predictable requirements and allow for them in the transmission format.

Part 1 of this paper discusses the requirements of a consumer HDTV transmission system. Part 2 shows how these requirements provide the basis for HDB-MAC; a conditional access satellite transmission format.

1.0 REQUIRED HDTV SIGNAL ATTRIBUTES

High definition TV has been proposed for a variety of applications having different sensitivities to picture quality and cost. This has led to a number of transmission format proposals with a range of characteristics. However, consumer HDTV has a set of specific constraints which demands optimization of the format without consideration of other applications.

The design of the HDTV transmission format should begin with the offer which is to be made to the consumer.

A successful HDTV format must allow an offering which will be acceptable to the end consumer.
That implies the following four minimum requirements:

A) The TV set must be perceived to provide a significantly enhanced viewing experience.

B) The TV set must be reasonably priced.

C) The TV set must be capable of displaying all existing NTSC channels as well as HDTV programs.

D) Attractive HDTV programming must be available at a reasonable price, preferably through a number of different distribution channels.

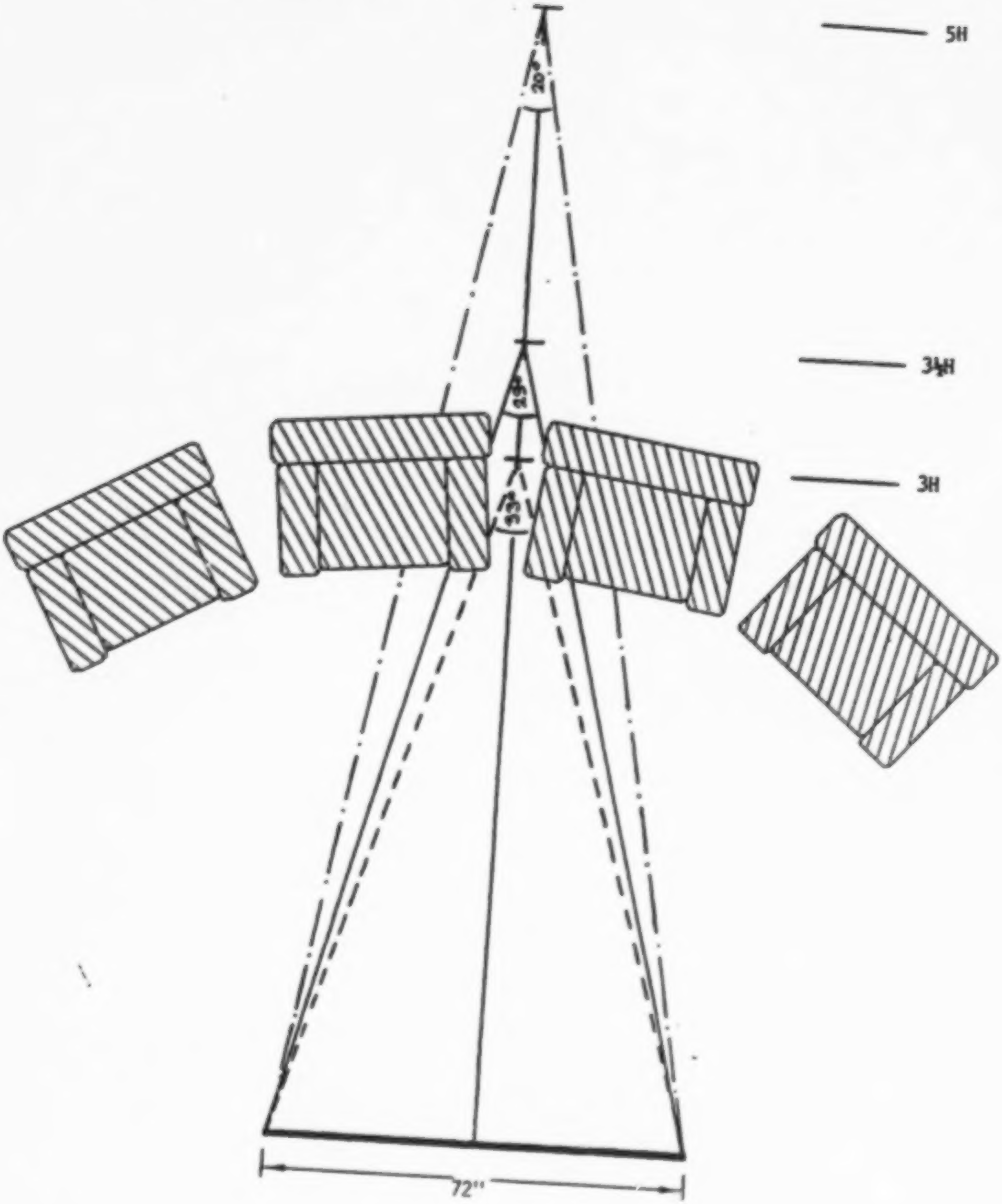
Although there are other requirements (for example, ease of installation), these four are the major ones from the consumers viewpoint. Each of them directly or indirectly carries implications for the transmission format. They will be referenced below as critical requirements A, B, C and D.

1.1 RESOLUTION

The quality provided by standard NTSC is perfectly adequate when the picture is viewed at distances greater than 5 x picture height (5H). Typically, viewing distances in the home are between 5H and 9H. HDTV becomes desirable only when the viewing distances become smaller. In cinemas, where seating arrangement are optimized and picture resolution is higher, most viewers choose a distance of 3H or greater. Due to room size and other considerations, most homeowners would not wish to accommodate a TV screen much greater than 6 feet wide (72" x 40" in 16:9 aspect-ratio).

Fig.1 shows the consequence of arranging four average sized arm chairs around a 72" x 40" screen, all at distances of 3H. The viewing area is overcrowded, and two of the four viewers have a viewing angle of 35° off-axis. Thus, even for the largest screen size practical in a modern home, a viewing distance of 3H represents an absolute minimum. It is more likely that viewing distances will be in the 3.5 - 4.5H region. The NTSC signal (decoded using standard methods) provides a resolution which is almost exactly balanced in the horizontal and vertical directions on a 4:3 aspect-ratio screen (440 lines/pw, 320 lines/ph).

FIG. 1 VIEWING A SIX FOOT SCREEN AT 3H


5H
3½H
3H
20°
29°
33°
72"

Decreasing the viewing distance from an acceptable NTSC value of 5H to 3.5H increases viewing angle by less then 50% (e.g. in the case of a 6 feet wide screen from 20.4° to 29°, see Fig.1). We therefore need to increase vertical resolution from the normal NTSC value of 320 lines/ph to approximately 320 x 1.5 = 480 lines/ph. We also need to match the vertical resolution in the horizontal direction. On a 16:9 aspect-ratio screen, the corresponding horizontal resolution is 480 x 16/9 = 850 lines/pw. This is equal to approximately double the normal NTSC value of 440 lines/pw, the additional horizontal increase being necessary because the screen aspect-ratio also increased from 4:3 to 16:9.

HDTV picture quality on a 16:9 aspect ratio screen in a practical home environment requires a resolution in the region of 480 lines/ph by 850 lines/pw.

Greater resolution will not be required either now or in the future, unless room sizes in typical homes increase significantly, or rooms are totally dedicated only to HDTV viewing. This conclusion is significant because overstating the resolution requirements will increase costs in transmission, reception and display without providing any effective benefit to the end user.

It is often said that HDTV requires a resolution twice that of NTSC. While this is true for the horizontal direction, it cannot also be true for the vertical, because the screen width increases more than the screen height. The foregoing argument shows that a 50% increase in the vertical direction is sufficient. The distinction is important because, as will be shown, a 50% increase in vertical resolution can be achieved while simultaneously maintaining compatibility with the 525-line structure of NTSC. This fact has important implications for the achievement of critical requirements **B** and **C** above, (namely HDTV set cost, and the display of standard NTSC signals). Demonstrations of 3H viewing of HDTV signals with 480 lines vertical resolution have been made on numerous occasions (particularly at NAB and NCTA 1989).

1.2 ASPECT-RATIO

In the discussion of resolution, it was assumed that the aspect-ratio of the final HDTV display will be 16:9. Since critical factor **C** requires standard 4:3 NTSC reception, this creates some problems of compatibility. In the HDTV set, it will be necessary to have the capability of displaying both 4:3 and 16:9 aspect-ratio pictures.

Two methods have been suggested for achieving dual aspect-ratio in the HDTV set. They are known as "letterbox" and "electronic curtains". Both are illustrated in Fig. 2. The objection to the letterbox approach is that the wide-screen picture is actually smaller in area than the 4:3 NTSC picture. The "electronic curtain" method is more acceptable from the marketing viewpoint but causes difficulties for any HDTV format based on augmenting standard NTSC transmissions. The augmentation signal now has to carry side panel segments to allow reconstruction of the complete 16:9 aspect-ratio-picture, and the HDTV set must contain the necessary processing to implement an invisible join between the side panels and the central panel.

Given these complications, a case can be made that wide aspect-ratio is not worth the trouble, and HDTV should simply remain 4:3 aspect-ratio. However, there is an important objection to this view which concerns market differentiation.

There is a real possibility that a 4:3 aspect-ratio HDTV system might not achieve sufficient differentiation in the public mind to be accepted as a new and improved television system, (critical requirement **A**). Ever since it's introduction, the size and quality of standard NTSC pictures has been increasing. 4:3 aspect-ratio HDTV might be seen as simply another step in that direction; a luxury receiver sometimes purchased by the rich when their present TV set wears out.

The term High-Definition Television is actually a misnomer. An HDTV picture viewed at 3H provides no more definition than an NTSC picture viewed at 5H; nor does it need to. If the aspect-ratio of the picture is unchanged from NTSC, the only marketing advantage of HDTV is the picture **size**. Subjective tests have shown that, as viewing angles increase, wide-aspect-ratio has a perceived advantage to the viewer. However, its main advantage is that it offers a second differentiating factor for HDTV which is obvious to the consumer **even when the receiver is turned off.**

The valid objective of TV set manufacturers must be to make an offer sufficiently tempting to the consumer to cause replacement of a high proportion of NTSC sets. Only high volume manufacture will cause costs and prices to become reasonable (critical requirement **B**). If manufacturers do not believe that such a mass market will develop they are unlikely to invest in the technology, and consumer HDTV will not happen. Wide aspect-ratio will become an important factor in the calculations made by manufacturers when making their investment and pricing decisions.

There is also a second problem associated with proposing a 4:3 aspect-ratio HDTV system. Industry hype concerning wide aspect-ratio HDTV is now such that no 4:3 system would be likely to gain acceptance as more than an interim step. (16:9 displays will soon be in manufacture in both Europe and Japan). Acceptance of a 4:3 system by broadcasters and set manufacturers would therefore be slow at best.

If 16:9 aspect-ratio is to be adopted essentially for its marketing advantage then the "electronic curtain" method is surely the best. Unlike the "letterbox" technique, it offers more picture to the buyer of the new, extra wide TV set than the standard NTSC viewer. It also offers more picture area when tuned to the HDTV channel rather than less.

Due to the uncertainty concerning aspect-ratio, HDB-MAC has been designed to handle both 4:3 and 16:9 transmissions.

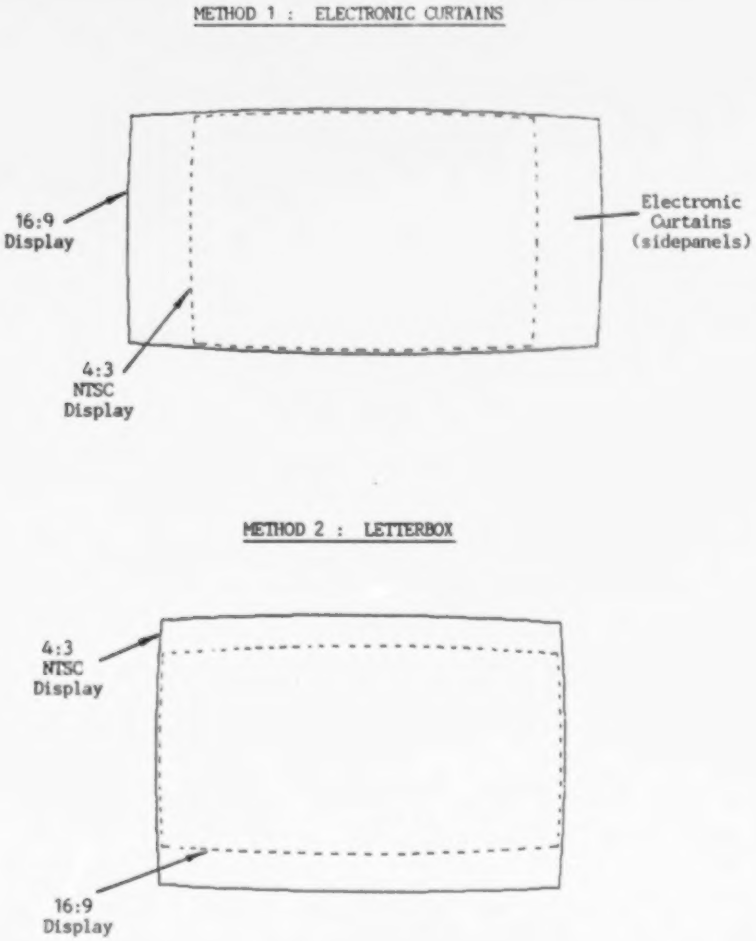
1.3 NTSC COMPATIBILITY

The term "NTSC Compatible HDTV" refers to an HDTV transmission format which can be directly received with NTSC quality by a standard NTSC set. The idea is that existing NTSC transmissions could be enhanced by augmenting the signal, either within the present A.M. channels, or in a separate augmentation channel. In this case, HDTV transmissions could be started without obsoleting the current population of TV sets. At least, that is the normal argument. However, there is a difficulty with this justification of compatibility.

It is clear that the existing NTSC channels could not, under any imaginable circumstances, be terminated within the foreseeable future. Protection of the consumers investment in NTSC sets is therefore not a very relevant issue. The same argument could have been made concerning 78 r.p.m. record players. A significant transition to HDTV will occur only if the consumer is provided with a more tempting alternative.

The real argument is about transmission bandwidth and spectrum space.

Unless HDTV transmissions are NTSC compatible, it will be necessary to employ more bandwidth to accommodate both the NTSC channels and the incompatible HDTV channels. Access to additional bandwidth is always expensive, and may be impossible for terrestrial broadcasters.



METHOD 1 : ELECTRONIC CURTAINS

METHOD 2 : LETTERBOX

FIG. 2 THE DUAL ASPECT RATIO HDTV SET

All of the programs currently carried by standard NTSC are supported by advertising, and provided free of charge by the broadcaster. Transmitting these channels in HDTV would provide no additional income for the programme provider, since advertisements viewed in HDTV will have no more value than when viewed in NTSC. Consequently, there is no apparent reason for ad-supported channels to begin HDTV broadcasts.

The only TV channels which could benefit financially from HDTV are those which could differentiate the HDTV viewer, and bill him an incremental fee. Currently, these are exclusively Pay-TV broadcasters. However, Pay-TV broadcasters do not use NTSC. They scramble their signals with the deliberate intention of making them **incompatible** with existing TV sets. Only those viewers with a descrambler can receive the Pay-TV signals.

The new "off-premise" technology being introduced to the cable industry avoids the need for scrambling, but is not yet widely distributed. Moreover, it applies only to cable. Therefore, a conditional access HDTV signal will be required, at least for satellite transmission.

A strictly NTSC compatible HDTV signal could not be used by the only broadcasters with a financial incentive to initiate HDTV services.

This conclusion conflicts with critical requirement **D**, that attractive HDTV programming be available.

It therefore becomes clear that a single HDTV transmission format cannot satisfy all applications. At least two would be desirable.

The first is an unscrambled NTSC compatible signal employing augmentation signals within the 6MHz channel, or in a separate channel. This would be used for ad-supported services. It remains to be seen whether such a signal is technically feasible in practical cable and/or terrestrial broadcast conditions.

The second is an encrypted signal (not directly compatible with NTSC sets) which would be used by pay TV programmers at least on the satellite segment. The high definition B-MAC (HDB-MAC) system is designed to satisfy this second requirement.

PART 2 HIGH DEFINITION B-MAC (HDB-MAC)

HDB-MAC is a compatible development of the standard B-MAC signal which is briefly described below:

2.0 STANDARD B-MAC

The composite signals in use today (such as NTSC) are derivatives of the original black-and-white transmissions which began in the early 1940's. The enhancement of these signals to include color had to be achieved without obsoleting the original monochrome receivers. This resulted in the addition of the color-subcarrier at 3.58 MHz which causes minimal interference to these early sets.

The amplitude of the NTSC color subcarrier is a compromise between the interference which it causes to the luminance signal (cross-luminance), and color noise in amplitude modulated (A.M.) transmissions. The NTSC signal was introduced in 1953, and predates the invention of geosynchronous satellites.

The introduction of satellite TV transmissions required the use of frequency modulation (F.M.) rather than amplitude modulation. The noise characteristics of F.M. transmissions are significantly different from A.M. In particular, the F.M. noise spectrum is triangular, rising to a maximum in the region of the NTSC color subcarrier. Consequently, the NTSC signal is poorly matched to the requirements of F.M. satellite transmission.

In 1981, a project was initiated in the U.K. to design a new type of television signal, specifically optimized for F.M. satellite transmission. This resulted in the concept known as Multiplexed Analogue Components (MAC). MAC signals dispense with the color subcarrier, and employs time-compression to separate the luminance and color signals (Fig.3). An active TV line of luminance is time-compressed using a 3:2 ratio, and occupies 2/3 of the MAC video line. This makes space for the baseband color signals, which are time-compressed by 3:1, and occupy the remainder of the video line. Since the luminance and color signals are never simultaneously in the transmission channel they can be ideally separated in the MAC decoder. This eliminates interference effects such as cross-luminance and cross-color normally associated with NTSC. Moreover, without the NTSC subcarrier, the signal characteristics can be matched to F.M. requirements.

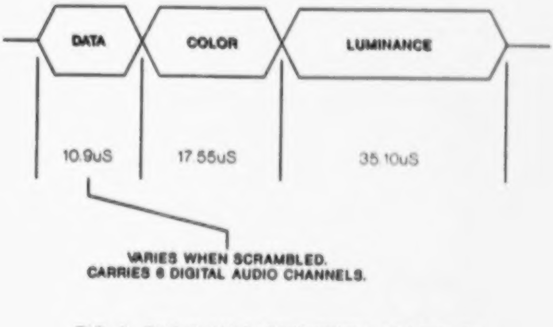


FIG. 3 THE B-MAC HORIZONTAL MULTIPLEX

There are a number of TV formats based on the MAC concept, including the 625-line D-MAC system standardized for satellite transmission throughout Europe. All MAC systems employ the same time-compressed video signal. B-MAC is the only 525-line MAC system. The B-MAC signal delivers 525-line component video (Y, R-Y, B-Y) in a 2:1 interlaced format, just like NTSC. Conversion to NTSC is accomplished using a single chip in the decoder.

All B-MAC decoders provide a standard 4:3 NTSC output, in addition to direct separate component outputs.

The MAC signal has a further advantage which is related to video scrambling. Fig.4 illustrates the storage device which decodes the MAC signal. It consists of a dual TV line store which is used in a ping-pong manner as follows:

An incoming video line is written into store A at a sampling rate of 21 MHz. At the same time, store B is being read out at a sample rate of 14 MHz. At the end of the TV line, the A and B stores are reversed, and store A is read out at the 14 MHz rate. The ratio of the read and write clocks (21:14) accomplishes the 3:2 time expansion of the luminance signal required in the MAC decoder. However, the dual line-store device also provides for hard video scrambling without incremental cost. Varying the time delay of the write clocks enables the transmitted line to be moved in time by a random increment, under the control of a time varying encryption key. Since the same components are used to implement both MAC decoding and hard video scrambling, the B-MAC system provides hard scrambling with no incremental cost in the decoder.
Similarly:

Where hard scrambling is required, MAC transmission has essentially the same decoder cost as scrambled NTSC, even when an NTSC output is required.

In B-MAC, the normal horizontal and vertical sync. periods of NTSC are replaced by data pulses. These carry six high quality digital audio channels, data and text services, and a separate information channel which controls access to all of the services in the signal. The B-MAC video/data multiplex is illustrated in Fig.5. The system provides the following features and functions:

- o separate component video and NTSC
- o six digital audio channels
- o colored text with graphics
- o data channels
- o hard video scrambling
- o encryption and conditional access

The first B-MAC networks were deployed in 1985, and there are now over 100 networks operating in over 20 countries worldwide. The standard B-MAC system was designed to provide a planned compatible upgrade path to HDTV. B-MAC decoders tuned to an HDB-MAC transmission generate a standard 4:3 aspect-ratio NTSC (or Y/C) image. Simultaneously, an HDB-MAC decoder can tune to the same transmission and generate a 16:9 aspect-ratio image with full HDTV quality.

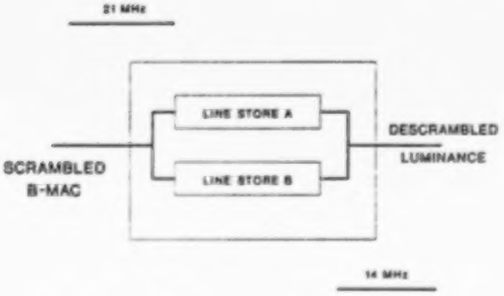


FIG. 4 B-MAC DECODER CHIP

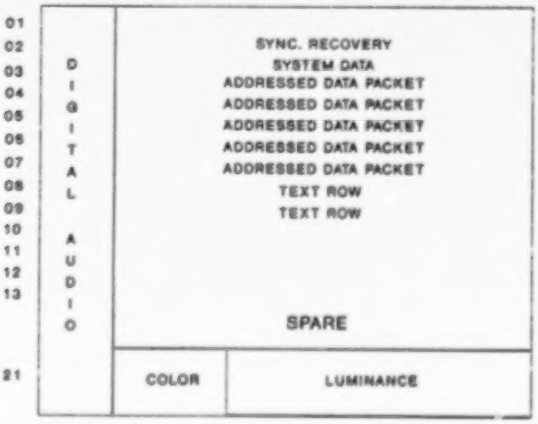


FIG.5 THE B-MAC VIDEO/DATA MULTIPLEX

2.1 HDB-MAC ASSUMPTIONS

The design of the HDB-MAC system is based on the following assumptions:

(1) The HDTV set must be capable of receiving standard NTSC as used on advertising supported channels. Display of these channels on a large screen demands that processing be present in the HDTV set to maximize the quality of NTSC. (This could be, for example, Faroudja processing followed by a high quality line-doubler).

(2) A conditional-access HDTV signal is required for pay TV channels, at least on the satellite segment. This signal must be incompatible with standard NTSC sets.

(3) A conditional access satellite HDTV signal must allow for a low-cost decoder which provides a normal NTSC output for non-HDTV applications.

(4) The transmission format should allow for both 4:3 and 16:9 aspect-ratio transmissions.

(5) The target resolution for a consumer HDTV display is 480 lines/ph and 850 lines/pw.

The first assumption above implies that the HDTV set must contain a high quality motion-adaptive scan multiplier to increase vertical definition of standard NTSC signals, and that the scan parameters of the final display will be simply related to 525 -line interlace. The simplest approach (which has been demonstrated by both Scientific-Atlanta and Faroudja Labs) is to double the number of displayed lines, and produce a 525-line progressive scan image.

Although the NTSC signal has 525-lines, the interlace process presents only half of that number in each TV field. The human eye is expected to average two fields in order to perceive a vertical definition equivalent to 525-lines. This averaging process is imperfect, and the subjective vertical definition which results is somewhere between 525-lines and half of that number (262 lines).

This apparent reduction of vertical definition caused by interlace is normally expressed by a scaling parameter known as Kell factor. A Kell factor of 2/3 is normally assumed. Taking into account that the number of active lines in NTSC is actually 480 (instead of 525) the vertical definition achieved by NTSC is 480 x 2/3 = 320 lines / picture height.

This figure is universally accepted in the industry. Although NTSC only achieves 320 lines/ph of vertical resolution, it is clear that there is sufficient information in the signal to achieve the full value of 480 lines at least for static images. This is apparent simply by noting that if the lines from two adjacent fields of NTSC are interleaved, and presented in a single field (ie. 525-line progressive scan), the full value would be achieved. However, this method is effective only for static images.

In areas of motion, it is necessary to interpolate additional lines using information from a single field in order to avoid blurring of the image. This is the technique used by the motion-adaptive scan doubler illustrated in Fig 6, and it achieves a vertical definition for static images of 480 lines/ph. In moving areas, the vertical definition is no greater than NTSC, but this has been found to be acceptable to the HDTV viewer.

The appropriate conclusion is that the HDTV set will contain some type of motion adaptive scan converter which accepts a standard 525-line 2:1 interlace input signal, and will achieve 480 lines of static vertical resolution.

This device will be present to ensure that NTSC signals presented on the large HDTV screen will have good quality.

To minimize total cost in the HDTV set, **all HDTV transmission format proposals should make use of this signal processing** for improving vertical NTSC definition. Transmission formats should therefore deliver a 525-line 2:1 interlace signal (just like NTSC), and concentrate only on improving horizontal definition. Improving vertical definition can be safely left to the processing which must be present in the HDTV set to allow NTSC viewing. That is the thinking behind HDB-MAC.

INCREASING VERTICAL RESOLUTION

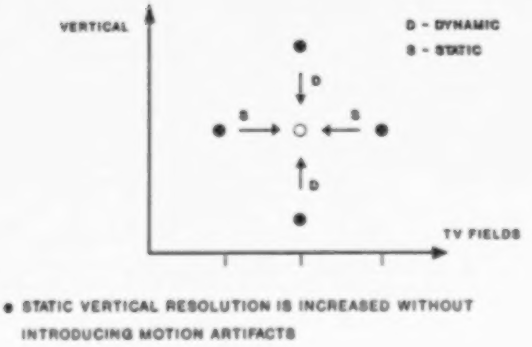

VERTICAL
D - DYNAMIC
S - STATIC
D
S
S
D
TV FIELDS
● STATIC VERTICAL RESOLUTION IS INCREASED WITHOUT INTRODUCING MOTION ARTIFACTS

FIG. 6 MOTION-ADAPTIVE SCAN DOUBLER

2.2 THE HDB-MAC SIGNAL

The HDB-MAC signal is identical with standard B-MAC in all respects other than the video spectrum. Therefore it delivers all of the features associated with standard B-MAC, including:

- o Six digital audio channels
- o Colored text with graphics
- o Data Channels
- o Hard video scrambling
- o Encryption and conditional access

Only the video signal is modified. The line structure of the video signal itself is also unchanged. HDB-MAC continues to deliver a 525-line interlaced signal (as does standard B-MAC). Motion-adaptive scan doubling is assumed to be a process which will be present in the HDTV set for the presentation of standard NTSC channels, and will achieve the necessary vertical resolution. (Since the first HDB-MAC decoders will be used mainly with projection systems, they will also have a built-in motion adaptive converter, and generate a progressive-scan HDTV output).

HDB-MAC modifies the standard B-MAC video signal in only two ways:

(i) Dual Aspect - ratio
(ii) Increased horizontal resolution

Dual Aspect-Ratio

The capability for 16:9 aspect-ratio transmission is built into the system by allowing for a second time-compression factor in the MAC video signal. Normally, the MAC luminance signal consists of a 4:3 aspect-ratio image, time-compressed by the ratio 3:2. A 16:9 aspect-ratio image can be made to fill the same active line period, in which case a central 4:3 segment of the image occupies a time duration which is only 75% of its previous value, as shown in Fig 7.

COMPATIBLE 16:9 ASPECT RATIO TRANSMISSIONS

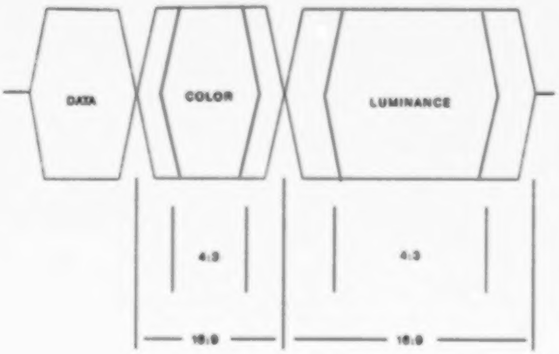


FIG. 7 DUAL ASPECT RATIO

As described above, standard B-MAC decoders contain a video line-store which accomplishes the 3:2 time decompression of the luminance signal. In the case of a 4:3 image, the signal is clocked into the line store at a sample rate of 21 MHz, and clocked out at 14 MHz. In the case of a 16:9 transmission, it is only necessary to decrease the frequency of the output clock to 10.5 MHz during a selected portion of the line, and a 4:3 segment of the 16:9 image will be expanded to fill the whole active line. This will be converted to a standard 4:3 aspect-ratio NTSC signal of the correct geometry. Since the line stores are already part of the standard B-MAC decoder, dual aspect-ratio compatibility is achieved without any incremental cost.

Increased Horizontal Resolution

The standard B-MAC signal occupies a baseband bandwidth of 6.3 MHz. After 3:2 time expansion of the luminance signal, the bandwidth achieved at the decoder output is 4.2 MHz (2/3 x 6.3 MHz). This matches the requirements of NTSC. To increase the horizontal resolution in HDB-MAC we first increase the signal bandwidth from 6.3 MHz to 14.5 MHz (more than doubling the resolution) This signal now has too much bandwidth to pass through normal F.M. satellite channels. The signal spectrum is then folded back on itself at a frequency of 10.5 MHz as shown in Fig. 8.

Spectrum folding is possible because repetitive signals such as line scanned television have a spectral density concentrated on harmonics of the repetition frequency (namely line-frequency). The TV spectrum therefore consists of packets of energy located at exact multiples of line-frequency, with not much energy between them. Careful selection of the fold frequency ensures that high frequency packets interleave with lower frequency packets without interference. In the case of HDB-MAC, the folded spectrum has a bandwidth of 10.5 MHz. The process is reversible in the high-definition decoder using only line memories and comb-filters.

As can be seen from Fig 8, the folded energy is not allowed to extend below 7 MHz. This means that the standard B-MAC decoder (which has a low-pass filter at 6.3 MHz) does not even see the complex spectrum above 7 MHz, and continues to operate as if the transmitted signal is standard B-MAC.

HDB-MAC LUMINANCE PROCESSING

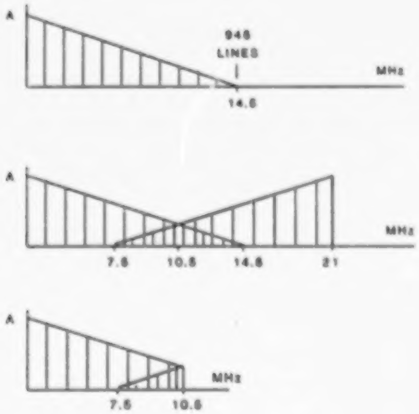


FIG. 8 SPECTRUM FOLDING

Experiments have shown that the 10.5 MHz HDB-MAC signal can pass through standard satellite transponders with only a modest reduction of deviation of approximately 1db compared with standard B-MAC signals.

The horizontal resolution achieved by HDB-MAC is equivalent to a standard MAC signal with bandwidth 14.5 MHz. Since the time compression factor is 3:2, the effective luminance bandwidth is 14.5 x 2/3 = 9.7 MHz which corresponds to a horizontal resolution of over 1000 lines for the interlaced signal. (Taking into account practical filter characteristics, we achieve 950 lines). This exceeds the target consumer HDTV horizontal resolution by a comfortable margin.

The motion-adaptive scan conversion process which increases vertical definition in the HDTV set has the effect of halving the duration of each line, and doubling the bandwidth of the signal. Consequently, the bandwidth of the luminance signal which actually reaches the display is almost 19 MHz.

2.3 HOME EQUIPMENT CONCEPT

Fig. 9 shows the system concept from the viewpoint of the consumer. The HDTV set accepts NTSC signals, and executes advanced decoding to produce high quality separate components (Y,R-Y,B-Y) with 2:1 interlace. These signals are processed by a motion-adaptive scan converter which increases vertical definition and generates a 525-line progressive scan display. The scan converter must contain several field stores, and is the most expensive part of the processing. Its presence is dictated by the need to display standard NTSC signals.

The conditional-access HDB-MAC decoder resides outside the TV-set, and connects directly to the scan converter using a 2:1 interlaced component interface with 950 lines of resolution.

The processing necessary in the HDB-MAC decoder includes MAC decoding and spectrum unfolding. These operations are implemented using only line-storage; field stores are not required.

2.4 SUMMARY

The HDB-MAC system is optimized for encrypted HDTV transmissions employing F.M. modulation, particularly via satellite.

It is designed to minimize decoder cost, on the assumption that a consumer HDTV set must contain signal processing to optimize the quality of standard NTSC transmissions. The HDTV set will therefore contain a scan multiplier which accepts 525-line 2:1 interlace separate component signals. By using this scan multiplier to enhance vertical definition, HDB-MAC minimizes costs external to the TV-set for a conditional-access HD system.

HDB-MAC is a fully encrypted and hard-scrambled conditional-access system. It delivers separate component video, six digital audio channels, data and text services.

The system delivers either 16:9 aspect-ratio or 4:3 aspect-ratio images. The HDB-MAC signal is compatible with standard B-MAC decoders for non-HDTV subscribers. These always produce a standard 4:3 NTSC image even during 16:9 HDTV transmissions.

Standard B-MAC decoders have a cost which is similar to scrambled NTSC decoders which offer hard video scrambling.

The HDB-MAC system delivers a resolution of 480 lines/ph and 950 lines/pw. These figures exceed requirements for consumer HDTV.

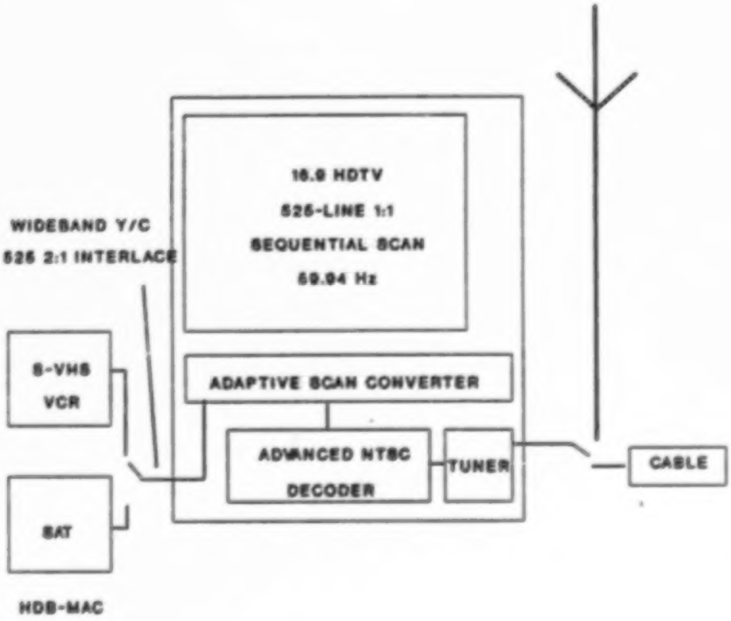

16:9 HDTV
525-LINE 1:1
SEQUENTIAL SCAN
59.94 Hz
WIDEBAND Y/C
525 2:1 INTERLACE
S-VHS
VCR
ADAPTIVE SCAN CONVERTER
ADVANCED NTSC
DECODER
TUNER
CABLE
SAT
HDB-MAC

FIG. 9 HOME EQUIPMENT CONCEPT

HDTV Standards and National Media Policies: Cultural Considerations (1)

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Eugene, Oregon 97402

1. ABSTRACT

When adopting new telecommunications standards, governments face a dilemma. Endorsing international standards promotes the free flow of information and trade. Rejecting them strengthens national security and protects domestic manufacturers. This predicament is creating tension among the organizations that are shaping high-definition television (HDTV) policy in the United States. Focusing on these organizations, the following political-economic analysis examines how their conflicts are affecting both domestic and international HDTV policy.

2. INTRODUCTION

Many nations are experiencing unsettling political and economic changes as they move from industrial-based to information-based societies. While the rapid development and deployment of new communications systems are driving these changes, cultural differences modify these systems, affecting their use. These modifications, in turn, transform the culture (2).

Because of this interdependence between culture and technology, choosing a particular technical standard has important political and economic implications. A government must ask if the ability to communicate freely with other nations outweighs the advantages gained by adopting incompatible systems, which would help preserve its culture. The problems created by this dilemma have thwarted attempts to adopt an international HDTV transmission standard so far (3).

Comparing the effects of marketplace and cultural factors on French and U.S. communications policy decisions, this report examines whether an international HDTV standard is feasible, or even necessary.

3. THEORETICAL CONSIDERATIONS

Many governments use technical standards to stimulate private-sector industries or to protect a specific market from foreign domination. This approach is especially common in the case of high-definition television systems. While these issues are not trivial, they do conceal the broader issue of world market domination (or the fear of world market domination). Therefore, this political-economic analysis focuses on how increasing conglomeration and privatization are affecting national and international regulatory policy (4).

The thesis developed within this framework suggests that a competitive world economic system hinders the development of international technical standards. Furthermore, marketplace ideology and regulatory structures, rooted in the cultural concept of "free enterprise," inhibit the rapid adoption of national technical standards. As a result, domestic industries are less competitive in the world market.

4. U.S. TELECOMMUNICATIONS POLICY AND THE WORLD MARKET

The search for a universal high-definition television standard is generating many heated debates, both internationally and domestically. In the United States, reaching an agreement has been particularly difficult. Many people believe that the fortunes of the U.S. electronics industry hinge on adopting a unique HDTV system (5). They argue that the U.S. accounts for a dominant share of the $0.5 trillion world market (6). A unique HDTV system would allow the U.S. to control the domestic market and rejuvenate its semiconductor production and tooling industries at the same time. Other groups, however, argue that a universal standard would result in lower costs for consumers and transnational corporations.

These people, who shape telecommunications policy in the United States, are members of one or more of the following groups: independent standards organizations, lobbying organizations, the various branches of government (Legislative, Executive, and Judicial--including Congressional committees and sub-committees, regulatory agencies, and the Department of Defense), domestic and foreign manufacturers and distributors, and consumers.

4.1 INDEPENDENT STANDARDS ORGANIZATIONS

Although many professional organizations such as the Institute of Electrical and Electronic Engineers (IEEE) and the Society of Motion Picture and Television Engineers (SMPTE) develop many of the manufacturing standards used in the U.S., the coordination of these standards is carried out by the American National Standards Institute (ANSI).

While ANSI licenses manufacturers whose products conform to its standards, their guidelines are only recommendations. They do not enjoy the same status as government regulations. Manufacturers are free to develop their own "standards," and often do. Examples of this type of "selected standardization" include VHS and Beta videocassette machines and IBM-type and Apple personal computers.

Relying on voluntary cooperation and the marketplace to determine "standards" produces customer confusion. Consumers become wary of buying expensive products which may quickly become obsolete. Manufacturers hesitate to invest heavily in research and development. Many financial institutions and stockholders are unwilling to lend capital for low-return, high-risk ventures. An example is AM-stereo radio. After choosing a standard, the Federal Communications Commission (FCC) reversed its decision and opted to let the marketplace select the standard. While several stations are transmitting stereo programs (using incompatible systems), few, if any, stereo receivers are available.

Incompatible HDTV standards are also creating some problems which may affect the short-term development of HDTV. Not only have Japan, Europe, and the United States proposed different sets of standards, but several manufacturers in each of these countries have also promoted their own incompatible systems. For instance, in the U.S. almost two dozen proposals have been submitted to the FCC's Advisory Committee on Advanced Television Service. In fact, this confusion may alter the perceptions of consumers and hamper the growth of HDTV. HDTV growth projections vary considerably, depending on the organization conducting the survey. For instance, the Electronic Industry Association (EIA) originally predicted that 10% of U.S. households would have HDTV within four years after its introduction and 25% of U.S. households would have it by the turn of the century. On the other hand, more conservative groups, citing color television's development time, feel that it will take at least twenty years before HDTV will make any significant inroads (7).

4.2 CONFLICTING GOVERNMENT POLICIES

The confusion within the HDTV industry is also reflected in policy statements issued by various government agencies during the past year.

After holding a series of hearings on HDTV in 1988, John Dingell (D-Mich), chair of the House Energy and Commerce Committee, concluded that Congress should move quickly to make sure rivalries wouldn't hinder the development of HDTV. Representative Dingell expressed concern that U.S. companies couldn't compete successfully in the world video market without government help (8). This concern was also expressed by other legislators, who felt that the question was not whether the government should support industry, but whether the government or industry should take the initiative in financing HDTV research (9).

While Congress has appeared eager to support domestic HDTV manufacturing (including proposals to exempt HDTV corporations from antitrust laws and to fund joint government-industry research and development programs), the FCC has moved very cautiously as it attempts to address the concerns of over-the-air broadcasters.

In 1988 the FCC issued a Further Notice of Inquiry in the matter of HDTV (10). The Commission declared that, according to the Communications Act of 1934, it must maintain a viable local broadcasting system. It concluded that consumers would receive the benefits of HDTV most quickly if the signal were NTSC compatible. Therefore, the Commission decreed that any HDTV signal must use essentially the same amount of space in the VHF (very high frequency) and UHF (ultra high frequency) bands as present-day transmissions (11).

These antithetical responses emphasize the problems facing the government as it tries to draft a new telecommunications policy. In this case, Congress is trying to make the U.S. a global force in the electronics equipment market, while the FCC is attempting to protect the domestic broadcasting market. While these goals do not have to be mutually exclusive, they appear to be, for each party's arguments are constructed within a traditional political-economic framework.

The "free enterprise" system is deeply rooted in U.S. culture. It seems to function as it was intended in the domestic market. This system works somewhat differently, however, in the world market. In fact, the world market doesn't recognize individual industries as competitors, but countries. Therefore, countries that present a united manufacturing front stand to grab a larger share of the world market than those countries represented by several companies busily competing among themselves. This philosophical dichotomy (strong competition at the domestic level and a monopoly at the global level) has created an unresolvable problem for the U.S. at the policy-making level.

Some of these problems were recently acknowledged in a report released by the National Telecommunications and Information Agency (NTIA) (12). This report was particularly critical of the present method of telecommunications policy-making. It pointed out that:

> International, and sometimes domestic, telecommunications and information policy is often reactive and skewed toward achieving short-term objectives, focusing too much on maintaining the status quo, despite the influx of technological innovation and marketplace pressures (13).

The report went on to say that the current policy-making structure was also susceptible to various "divide-and-conquer" techniques used by "foreign-based" organizations (14). To counteract this problem, the NTIA committee recommended that the Executive branch of the government be given the authority to make telecommunications policy instead of the Legislative branch. If this recommendation were implemented, the FCC would merely carry out the Executive branch's policy decisions. On the other hand, if this change was not adopted, the NTIA recommended that the Executive branch be given the authority to disprove FCC actions directly rather than having to go through lengthy court proceedings or having to initiate legislation in the House of Representatives (15).

The NTIA also pointed out that many countries have national industrial policies which limit foreign access to domestic markets while they target foreign markets for subsidized entry. In this respect "communications infrastructure development, standards development, and spectrum resource allocation have a direct effect on [the] international trade balance in telecommunications equipment and services" (16).

By the end of 1988 the Department of Defense (DOD) had arrived at the same conclusion. The Defense Advanced Research Projects Agency (DARPA) announced on 28 December 1988, that $30 million would be available to develop low-cost, high-definition displays. The DOD explained that it was interested in developing HDTV technology because both HDTV and computers depend heavily on semiconductors. Thus, by supporting HDTV development, the DOD hoped to bolster on-shore semiconductor manufacturing (17). Since the incentive program was announced, however, officials have determined that federal regulations require open competition; therefore, the Pentagon grant program was opened to foreign bidders. This determination, of course, negated the intent of the program (18).

The conflict between telecommunications policy goals and regulatory reality can also be found in other government departments. For example, officials reported that in a June 1989 meeting of the newly created Council on Competitiveness, Mr. Mosbacher (who wants more government help for private industry) strongly disagreed with the position held by the chairperson of the Council of Economic Advisors, the budget director, and the domestic policy advisor concerning the aims of U.S. telecommunications policy (19).

4.3 INDUSTRY LOBBYISTS

While the three branches of government shape telecommunications policy in the U.S., lobbyists play a decisive role in determing the issues according to many media analysts (20). This assumption is based on the fact that the telecommunications industry in the United States is private and driven by a marketplace ideology. This deliberate emphasis on commercialism has been further strengthened by government deregulation (21).

These lobbyists are successful for several reasons. They operate on a continual basis. This allows them to respond quickly to technological change. In addition, the increasing complexity of technological and financial details creates problems for judges, who have no specialized training in economics or technology, and politicians, who attempt to interpret the information presented by industry experts (22).

4.4 DOMESTIC AND FOREIGN POLICY COORDINATION

Many of the conflicts that exist among the governmental agencies involved in telecommunications policy decisions can be traced to the Nixon administration's attempts to influence broadcasting content during the Vietnam War and the Watergate Crisis. The effects of this pressure were felt throughout the Ford, Carter, and Reagan years. As a result, domestic and foreign policy goals were never made clear. No attempt was made to reconcile the differences among the three major executive departments: Defense, State, and Commerce.

The divergent viewpoints of these departments become readily apparent after looking at their goals:

1. promote an environment in which ideas and information can flow more freely among nations
2. ensure the continued technological and economic strength and leadership of the U.S. in communications
3. ensure our national security and strategic communications capabilities
4. encourage international commerce of all kinds through the efficient and innovative use of communications resources
5. expand the information access and communication capabilities of developing countries (23).

Asked how these goals might be realized, the Coordinator for International Communication and Information Policy replied: "These objectives can most effectively be achieved by relying whenever possible on free enterprise, competition, and free trade with a minimum of direct government regulation" (24).

So, U.S. telecommunication policymakers, during the 1980s, were not only interested in exporting goods and services but they were also attempting to export the notion of deregulation. Before embarking on this road to deregulation, however, other countries should evaluate its long-term effect on domestic telecommunications systems and its effect on international trade.

4.5 MANUFACTURERS AND DISTRIBUTORS

While government agencies are moving in many different directions as they grapple with the question of HDTV standards, several companies are cooperating in various ways so they may become more competitive in the global marketplace.

In January 1989, 18 corporations announced that they planned to form a for-profit organization. By pooling their resources, they hoped to capture a large part of the HDTV hardware market (25). This limited partnership would develop, fund, and manage, along with the federal government, one or more of the members' HDTV research and development programs. It would then license the resulting technology to other U.S. manufacturers. Finally, it would direct the technology of its member companies toward HDTV and related products (26). Nevertheless, no specific projects have been announced by the group.

In the first quarter of 1989, however, a joint operating agreement was announced between American Telephone and Telegraph (AT&T) and Zenith Electronics Corporation. Many analysts believed that this alliance was significant because it combined the research and semiconductor expertise of AT&T with the manufacturing capability and television technology of America's only domestic manufacturer of television sets, Zenith (27). Yet little information has been made public so far, and Zenith is now in the process of corporate restructuring.

Even though these manufacturers and distributors seem to agree on a common global marketing strategy, they actually are no more unified than the government.

4.6 CONSUMERS

The success of any advanced television system, however, will eventually depend on consumer acceptance. Before consumers will buy significant numbers of high-definition television sets, two problems must be overcome. The retail price of HDTV sets must be held at a resonable level (in the $800 to $2,000 price range), and consumers must be convinced they "need" to buy large-screen tvs. (Most people watch tv programs on screen smaller than 20 inches. High definition sets of that size don't offer appreciably improved picture quality.) (28)

The size factor is important because 75% of all televisions sold in 1988 were less than 21 inches in diagonal measurement. Unless a large number of these viewers can be persuaded to spend hundreds of dollars more on much larger television sets, HDTV will have a difficult time establishing itself except in specialized fields of business (29).

5. A COMPARISON OF NATIONAL MEDIA POLICY METHODS

One might conclude that the processes which shape U.S. telecommunications policy are unique. Telecommunications systems are privately owned and operated. Policy-making agencies are part of a complex federal system designed around the concept of "checks and balances." What must be remembered, however, is that *cultural ideology* is as important as the *political structure* in shaping a nation's domestic and foreign policies.

Many similarities can be found, for example, between the arguments presented by the French government supporting their adoption of a unique color television standard (SECAM: Sequential a Memoire) in the early 1960s and the arguments now being presented by the U.S. concerning HDTV standards.

5.1 THE DEVELOPMENT OF COLOR TELEVISION SYSTEMS

During the late 1950s and early 1960s, the French government decided that it would begin transmitting color television programming. The only color transmission standard was the NTSC standard developed by RCA, a U.S. company. This standard had been formally adopted by the United States in 1954, and some color programming was being offered over the RCA-owned National Broadcasting Company network.

Western Europe and France, in particular, felt that a "technology" gap existed between them and the United States. The French feared that this gap would lead to "the permanent dependence of Europe on the United States for the technologies required for economic growth, public health, and national security." Whether this gap actually existed or not is irrelevant. The *perception* of its existence was an important part of France's rationale when it decided to adopt the unproven SECAM system developed by Henri de France (30).

5.2 STANDARDS AS PROMOTIONAL TOOLS

Adopting the SECAM standard not only signified France's independence, but also enhanced its international reputation in the global marketplace. France anticipated billions of dollars in licensing fees for the right to manufacture professional and consumer products using their standard. It also expected huge sales in such ancillary markets as television programming (31). To accomplish these goals, the French government had to solve two problems. First, they had to persuade manufacturers to use the SECAM standard as the *only* color television standard. Second, they had to create a market for these products and then find some way to keep expanding it. The first problem was solved by government intervention. The French government simply set very low royalty fees for domestic television equipment manufacturers. It then appealed to the companies to adopt the standard for the *prestige* of France (32). The government was partially successful solving the second problem by promoting SECAM as the "European standard" to foreign countries. This ploy was particularly successful in selling the system to many of France's former colonies.

The SECAM standard, then, was used as a promotional tool. In this way the French government was able to create export markets where none existed before. They were also able to exert pressure on domestic firms in the areas of production, promotion, and sales.

5.3 THE EFFECT OF CULTURAL FACTORS ON STANDARDIZED SYSTEMS

These marketing methods were not entirely successful, however. Because of long-standing nationalistic jealousies, the French refused to lower their licensing fees for the Germans. The unwillingness of the French to cooperate led to the development of another incompatible color system (PAL: Phase Alternation by Line) by Dr. Walter Bruch of AEG-Telefunken in Germany (33). This system would eventually evolve into the "European standard," although many variations of the three basic systems (NTSC, SECAM, and PAL) are still in use throughout the world. Yet, for the French, national political, economic, and cultural interests combined to override any thoughts of adopting an international standard based on the recommendations of Study Group XI of the International Radio Consultative Committee (CCIR) (34).

6. SUMMARY AND CONCLUSIONS

Returning to the dilemma posed at the beginning of this report, we see that, concerning the issue of HDTV, U.S. policy is moving in the direction of national protectionism. Recent U.S. government policy statements and national security rhetoric coupled with the trend toward limited partnerships and joint operating agreements in the private sector are following the same pattern used by the French when they adopted the SECAM standard twenty-five years ago.

6.1 THE SIMILARITY IN POLICY-MAKING APPROACHES

The unproven SECAM system was invented by a French scientist. It was developed by a French company [Compaignie Telegraph Sans Fils (CFS)], which then licensed the system to other manufacturers. An existing, well-developed and tested system (NTSC) was rejected, not because it was technically inferior, but because it had not been developed in France and the patent licenses were held by a foreign firm (RCA). The PAL system was developed in Germany for similar reasons.

The French, however, accomplished many of their cultural and marketing goals. This success was due largely to the highly centralized nature of the French government and its ties to manufacturers. The appeal to the television manufacturers' cultural heritage and national pride easily convinced them to adopt SECAM as the national standard. The government was also able to expand their international market easily because of their close ties to many French-speaking, former colonies.

The United States is now using many of these same strategies as it attempts to develop a national HDTV industry. To achieve this goal, however, the government must play a more active role in establishing a standard. Currently, the government is looking at the possibility of relaxing antitrust laws and providing tax breaks for HDTV manufacturers. Other possibilities include providing low-interest or government guaranteed loans and government research grants (35).

The FCC and other government agencies are busily trying to establish guidelines aimed at protecting already established businesses. In addition, the FCC has created the Advisory Committee on Advanced Television Service (ATS), made up of members of the television industry. This committee counsels the FCC on technical and public policy issues concerning the various advanced television systems (36).

The pressure to adopt a unique domestic advanced tv standard is mounting. The reason becomes obvious when one realizes how large the U.S. television market is. Over 20 million television sets are sold in the United States every year. Once the U.S. chooses a standard, it is likely that manufacturers will build sets to these specifications even if these standards differ from those used in Europe and Japan. These U.S. companies would hold the patent rights to this technology and would stand to make large profits from licensing fees paid by offshore manufacturers. Many people in the government and in private industry argue that this kind of control would strengthen the domestic electronic industry while also indirectly benefitting the national economy.

6.2 THE COMPETITIVE GLOBAL MARKET

As nations strive to be competitive in the global marketplace, their national telecommunications policy is shaped primarily by political and economic self-interest. We must not allow ourselves to be deluded, however, by simple mechanistic arguments supporting a particular technology or regulatory ideology. We must realize that cultural ideology also plays a major role in shaping both technology and its use in any society. A certain technology will have some cultural effect upon a society, but that society's culture will also alter the technology in some way. Therefore, arguments for national deregulation and privatization of an industry (especially a telecommunications industry) must be assessed not only from the perspective of global competition (political and economic), but also from a cultural standpoint.

Because of the cultural differences among states, each develops distinctive political and economic systems. If one state simply attempts to replicate the successful policies (trade, defense, telecommunications, etc.) of another to gain an advantage in the world market, its cultural differences may lead to political and economic instability in its domestic market. In the case of telecommunications systems, members of one society may embrace the technology, making it highly successful, while another society may reject it completely.

For example, France was able to exploit its domestic SECAM standard fully and export it because its government, at the time, was highly centralized. France also had a long history of national cartels and of protectionism. These political and economic factors are simply a manifestation of a part of France's cultural heritage. On the other hand, the United States has a reputation of being "wickedly competitive within itself" (37).

The type of cooperation that took place among the various government agencies, standards organizations, and entrepreneurs in France is alien to the United States.

6.3 COMPETITION IN THE UNITED STATES

Even if new antitrust legislation were to make joint ventures in telecommunications research and manufacturing possible, one should not be misled into thinking that U.S. semiconductor and television manufacturing jobs would be saved, nor would global market domination by any one nation force the creation of a universal HDTV standard. The emergence of a unified HDTV industry in the United States in the near future also seems highly unlikely. Instead, existing transnational corporations will probably take over smaller research and development firms. The remaining conglomerates, however, probably would not cooperate with one another. These companies would first try to recoup their high research and development and start-up costs. To accomplish this, they would attempt to gain a dominant share of the market by promoting their own patented system.

This struggle would continue until one system was overwhelmingly accepted by consumers or until frustrated consumers rejected the entire technology. Deregulation and privatization will only exacerbate this problem. Deregulation will mean less government control of production standards. Privatization will mean more entrepreneurs competing for the same dollars.

If this worldwide deregulation and privatization trend continues, the final arbiter of technical standards will be the software manufacturers and the consumer. Regardless of the quality of the system or the size of the corporation promoting the hardware, HDTV sets will only be purchased if cheap, quality software is made available in quantity for a given HDTV standard.

The Federal Communications Commission can only regulate the technical standards for over-the-air transmissions. This lack of industry-wide enforcement leaves a large gap in the government's plan to implement a single HDTV standard. The field is wide open for non-standard delivery systems to emerge.

Technologies in the past (e.g., the telegraph and telephone) were originally used as tools for commerce (banks, railroads, the stock market, etc.). Future technologies undoubtedly will be exploited first by business interests. HDTV can be used by the Defense Department, the medical profession, and even gambling resorts. None of these uses needs an NTSC, SECAM, or PAL compatible signal. Compact discs, fiber-optic cable, and VCRs also offer the consumer non-broadcast standard delivery systems.

If production companies begin to shift toward a certain HDTV format, it will have an excellent chance of becoming a de facto standard. The Beta/VHS controversy is an excellent example of how product availability eventually determined the technical standard. Unfortunately, this process may take years before a standard is determined. Standardization is not a requirement for global acceptance of a telecommunications technology. The innumerable types of television systems in use today supports this conclusion. The lack of standardization, however, does affect the availability of a technology. When a product's format must be modified, additional expenses are incurred, either during the production phase (when copies in various formats must be manufactured) or during the transmission phase (using "black boxes"). If a manufacturer must set up three or more production lines to make high-definition television sets for the Japanese, European, and U.S. markets, economies of scale are lost and labor costs increase dramatically. The result, of course, is a higher cost to the consumer. Furthermore, the cost becomes a limiting factor. Poorer countries and poorer people cannot afford the technology necessary to receive the information they need to compete successfully in a global market. In addition, the marketplace is effectively narrowed for the producers as well.

6.4 SUGGESTIONS FOR FURTHER STUDY

This report has covered only the principal telecommunications policy debates that have taken place in the United States since 1988. Each of the arguments needs to be researched more thoroughly using a combined political, economic, and cultural approach.

Recent mergers involving hardware and software manufacturers should also be analyzed more closely. The sale of Columbia Pictures, Inc. to Sony and the Time-Warner merger shows a growing interest by investors in this type of corporate combination (38). Moreover, these kinds of mergers coupled with hostle takeover bids are destabilizing many companies. Corporate boards have voted to sell many of their assets and to lay off many of their key personnel because of this financial drain. During the past year (1989), thousands of workers have been affected. Some have been laid off; others have taken advantage of early retirement plans. The loss of "buying power" caused by these layoffs will greatly affect telecommunications equipment sales. The indirect affects of these events on telecommunications policy decisions will be difficult to interpret, however.

Finally, more studies investigating deregulation and privatization issues should be undertaken. Most of the arguments made by various governments have been based on a rather simplistic and mechanistic view of technology and its impact on society. Until policy-making bodies acknowledge the more complex nature of the interaction between technology and society, successful telecommunications policies cannot be developed.

7. NOTES

1. Based on original material first presented in the HDTV Session at *Northcon/89*, Portland, Oregon, 17 October 1989.

2. Eileen Meehan, "Technical Capability Versus Corporate Imperatives: Toward a Political Economy of Cable Television and Information Diversity," in *The Political Economy of Information*, ed. Vincent Mosco and Janet Wasko (Madison, WI: The University of Wisconsin Press, 1988), 167-8.

3. Rhonda J. Crane, *The Politics of International Standards: France and the Color TV War* (Norwood, NJ: ABLEX Publishing Corporation, 1979), 2-7.

4. T.K. Hopkins, "The Study of the Capitalist World-Economy," in *World-Systems Analysis: Theory and Methodology*, ed. T.K. Hopkins and Immanuel Wallerstein et al. (Beverly Hills, CA: Sage, 1982), 13.

5. D. Christiansen, "Global implications of 'Make or Buy?'," *IEEE Spectrum*, 25 January 1989, 25.

6. Editorial, *New York Times*, 15 May 1989, A18.

7. "Report predicts growth in HDTV," *Daily Variety*, 1 December 1988, 21.

8. P. Harris, "HDTV championed as D.C. tunes into high-tech tv," *Daily Variety*, 8 September 1988, 1.

9. Rep. Mel Levine (D-Calif), *New York Times*, 7 November 1989, A24.

10. P. Harris, "HDTV, FCC on same wavelength," *Daily Variety*, 2 September 1988, 1, 27.

11. The FCC argued that HDTV transmissions must fit within the same bandwidth as the present-day NTSC signal because insufficient spectrum space was available to handle true HDTV transmissions. The FCC's acknowledgement that spectrum space is, indeed, scarce directly contradicts FCC arguments made in the early 1980s. The Commission stated then that spectrum scarcity was no longer an issue because of the advent of new technologies. How the FCC manages to resolve this issue will have a great impact not only on standards and systems, but also on content regulation in the United States.

12. Department of Commerce, National Telecommunications and Information Administration, *NTIA Telecom 2000: Charting a Course for a New Century*, ([Washington, D.C.]: U.S. Department of Commerce, National Telecommunications and Information Administration, October 1988), 15-20.

13. Ibid., 19.

14. Ibid.

15. This authority to directly override the FCC would pertain only to matters of national security, foreign policy, international trade, or economic policy. No specific definitions, however, were discussed in the report.

16. *NTIA Telecom 2000*, 20.

17. "DOD, industry, and government move to aid U.S. HDTV development," *The Institute: The Institute of Electrical and Electronic Engineers*, March 1989, 2.

18. For a more detailed account of international corporation reaction see *Daily Variety*, 6 March 1989, 30.

19. *New York Times*, 25 June 1989, sec. 4, 4E.

20. Deanna Robinson, "A Critical Approach to U.S. Communication Policy: 1983," in *PTC '83 Proceedings* (Honolulu, HI: Pacific Telecommunications Council, 1983), 2.

21. Jeremy Tunstall, *Communications Deregulation: The Unleashing of America's Communication Industry* (Oxford, U.K.: Basil Blackwell, 1986), 195.

22. Ibid., 126.

23. Ibid., 201.

24. Dianna Lady Dougan, prepared statement, U.S. Senate, *International Communication and Information Policy*, 19 October 1983, 17.

25. The companies originally involved were Hewlett-Packard Co., Varian Associates, Inc., Cohu Inc., Digital Equipment Corp., ITT Corp., Prometrix Corp., PCO, Zenith Electronics Corp., IBM Corp., Apple Computer Inc., Tektronix Inc., Raychem Corp., Motorola Inc., Micro Electronics Computer Technology, Texas Instruments Inc., Harris Corp., and AVX Corp. (*The Institute: The Institute of Electrical and Electronics Engineers*, March 1989, 2).

26. Ibid.

27. "Firms join to develop TV system," *Eugene, Oregon, Register-Guard*, 1 March 1989, 9B.

28. Bob Davis, *The Wall Street Journal*, 20 January 1989, B1.

29. *The Washington Post*, 21 May 1989, H1, H6.

30. Gilpin, (n.d.), 1968, 17-19, and Crane, 39.

31. Crane, 45.

32. Ibid., 71, 78.

33. Ibid., 12-13.

34. Ibid., 19.

35. "Focus sharpening on high-definition TV: Backers want a combined U.S. technological effort," *Eugene, Oregon, Register-Guard*, 17 February 1989, 11D.

36. H. Head, "The American view of HDTV," *Broadcast Engineering*, October 1988, 140.

37. Philip Elmer-DeWitt, "Battle for the Future," *Time*, 16 January 1989, 43.

38. "Columbia stock rises amid buyout rumors," *Eugene, Oregon, Register-Guard*, 26 September 1989, 1C.

Session 1.5

Development Issues

NOTES

Telecom 2001 in Canada
A Possible International Model

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Abstract

This paper deals with Canada's role as a telecommunications player in the global environment. It concentrates on select aspects of "middle power" nations like Canada as they attempt to compete on the world scene with major international power (United States, Japan, etc.) and players (Siemens, Ericsson, AT&T, Baby Bells, etc.)

Three specific areas are detailed. Namely, technology, market structure and regulation. In addition, some major comments are put forward concerning a new national telecommunication bill designed to establish a level playing field for all Canadian firms.

Canada plays a role of being a middle-range power which is both a positive and negative position. Clearly, Canada is not in the major leagues with the likes of Japan or the United States, but also it is clearly not a Third World nation. Canada represents a vibrant information-based economy with major international telecommunication firms, such as Northern Telecom. In addition, the Canadian government is well known for sponsoring major public policy research initiatives in the telecommunications field and has long been active in providing guidance and leadership in the communication sector. Frequently, other middle power nations ranging from Australia to Europe frequently look to Canada as a possible model in terms of their international decision-making in the communication field. Finally, in major United Nations agencies such as the International Telecommunications Union (ITU) and the United Nations Educational, Scientific and Cultural Organization (UNESCO), Canada plays a significant role far beyond its rather modest population size of 25 million people.

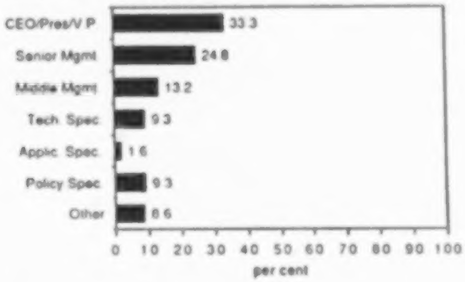
The key question is; what will Canada's role be in the future in terms of the telecommunications from a global perspective? And, secondly, what Canadian activities and future studies are there to draw upon as examples? The following details a major national telecommunication survey undertaken in 1989. It was conducted by the author and Brenda McPhail, President of McPhail Research Group.

Before I begin, I would like to highlight two background issues. First, telecommunications is the central nervous system of the information economy. If telecommunication policy, and clearly this also relates to telecommunication and information technology pricing, is out of step with major international trends and activities, then Canadian firms and the overall system will find itself in an extremely difficult position in terms of global markets. This refers not only to the telecommunication manufacturers ranging from Northern Telecom to I.P. Sharp, but also to all other services and manufactured items which are sold offshore. If Canadian telecommunication costs are significantly in excess of what the competitors are paying then clearly, our competitors have a better chance at winning bids for major offshore sales. A good example is the impact of the long distance tax imposed by the Minister of Finance. Essentially, Michael Wilson has hijacked the policymaking in this vital area from both the DOC and the CRTC. The net effect is, of course, that Canadian businesses have artificially inflated costs due to this long distance surcharge when compared with their major competitors -- whether they be from Europe, the United States, or Japan.

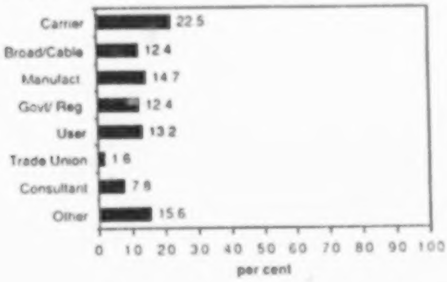
Second, industries are experiencing major redefinition of their traditional ways of doing business as well as accumulating profitability range from automobiles to tourism. An example I find particularly fascinating in terms of having a direct impact from telecommunication technology is the banking industry. I should also note that three banks were among the sponsors of Telecom 2001. Currently, banks receive almost exclusive profits on the basis of interest from various sources. Yet, it is predicted by the end of 2001 that as much as fifty per cent of banks' income could be from telecommunication-related services, particularly in two areas; namely, Smart Cards and Electronic Data Interchange (EDI). EDI is a means by which automatic transactions are undertaken through interconnected computer databases, thus eliminating much of the human handling and paperwork currently associated with mass, repetitive purchases. Firms such as Provigo of Quebec, General Motors and others, are already utilizing EDI for inventory control and supplies. In addition, Telecom Canada and CNCP are active in supplying appropriate software, communication networks, plus systems consulting for what will soon be extensive hook ups of major corporations with banks. One interesting facet, of course, will be whether these firms, particularly multinationals and those associated with U.S. parents, will hook into an EDI hook up via their U.S. parent company on a North-South basis rather than an East-West basis. This gets into the entire area of transborder data flow which should be examined more systematically both in light of the Free Trade Agreement and in light of the tremendous implications EDI will have.

The Telecom 2001: A Strategic Forecast study commenced over a year ago with funding from thirty clients representing major telecommunication firms, provincial and federal governments, the territories, and trade associations. It represents the largest study to date on the future of telecommunications in Canada. Much of the data collected and discussed is the result of a seventeen page questionnaire. It consisted of an extensive series of questions relating to the future configuration of the Canadian telecommunication sector to the turn of the century. Many of the 130 replies were from senior executives or regulators and thus, the data and findings are particularly rich. Also, many replies were from individuals who are very capable of making their predictions come true. They control corporate strategy and decision making in many cases.

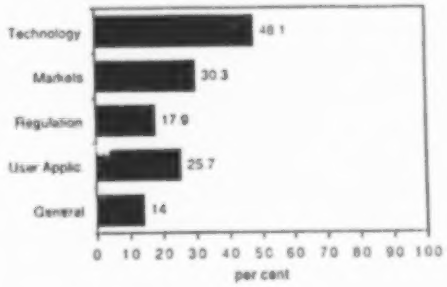
Table 1.1: Position



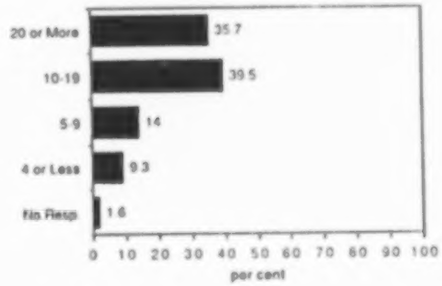
1.2: Sector



1.3: Specialization



1.5: Years of Experience



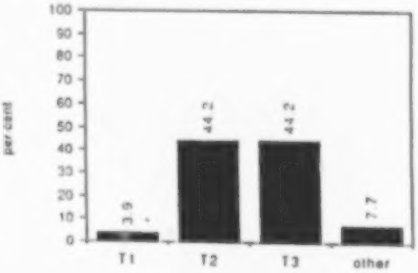
1. TECHNOLOGY

In terms of technology, there is a fundamental difference between this study and the initial 1985 study entitled Telecom 2000. The initial study found a significant amount of technological determinism where industry experts presumed that a great deal of change and a great deal of what affected the industry would simply come about due to technical forces and technological innovations. In the current study, that is no longer the case. Clearly, there is a strong consensus that technology is almost assumed or a given. That whatever technologies will be needed will be developed and that technological innovation will be consumer-driven and the marketplace will respond.

By the year 2001, power of computers will increase enormously, including speech recognition and language translation, plus, size and costs will decrease significantly. The power will double every two years. High definition television and ISDN will be commonplace. Cellular telephone technology will increase across Canada. There will be a substantial increase in smart buildings and the local area networks. A significant increase in the electronic mail and remotely-accessed databased services will be evident.

Concern about access to telecommunication technologies in rural and remote, particularly Northern, areas will be a major concern. Data indicated a preference for T_2 - evolutionary growth. Table 2.1 most accurate. They did so because they viewed T_3 - rapid growth as unrealistic rather than unacceptable.

Table 2.2 preferred.

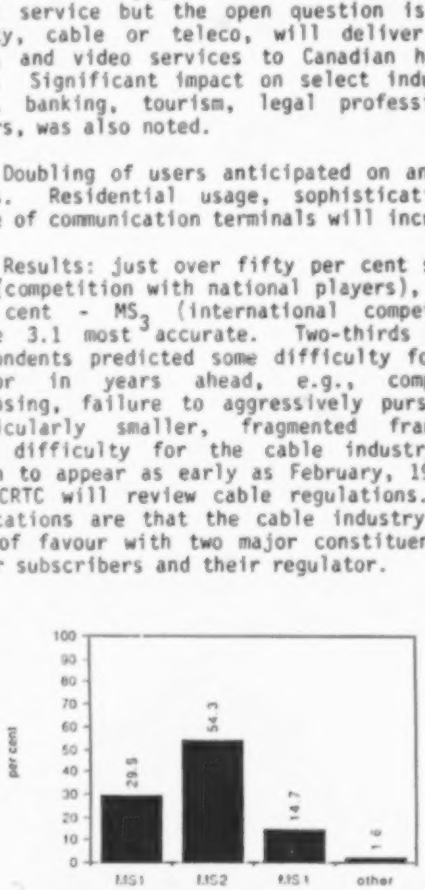


2. MARKET STRUCTURE

Business will demand more and better access to information services. Large corporations will build private networks and bypass public networks. Policy is not so much about competition being good or bad but it is inevitable; rather, how to structure the competition is what the debate is about. Local measure service (LMS) is likely to come in by the end of the study period. Some competition for local service but the open question is, which entity, cable or teleco, will deliver voice, data, and video services to Canadian homes by 2001. Significant impact on select industries, e.g., banking, tourism, legal profession and others, was also noted.

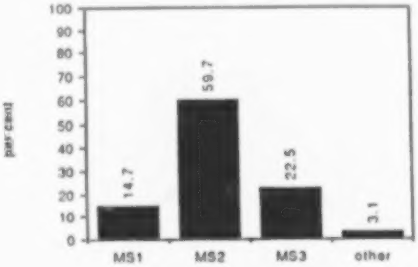
Doubling of users anticipated on an annual basis. Residential usage, sophistication and range of communication terminals will increase.

Results: just over fifty per cent selected MS$_2$ (competition with national players), fifteen per cent - MS$_3$ (international competition). Table 3.1 most accurate. Two-thirds of the respondents predicted some difficulty for cable sector in years ahead, e.g., competitive licensing, failure to aggressively pursue R&D, particularly smaller, fragmented franchises. This difficulty for the cable industry could begin to appear as early as February, 1990 when the CRTC will review cable regulations. Early indications are that the cable industry may be out of favour with two major constituencies -- their subscribers and their regulator.



In terms of market structure, there was a substantial change from the original 1985 study. This new study indicates that the market structure and marketing will influence the destiny of the telecommunications field. Also, a strong shift in emphasis to the international or global marketplace where future sales in India or Latin America will have more to do with the future of Canadian firms than additional sales in Prince Rupert, Red Deer or Hamilton. This offshore emphasis is also interesting to note because even major R&D facilities such as the Alberta Telecommunication Research Centre (ATRC) openly concede that their laboratory works on innovations which have clear international commercial potential. They do not, and I suspect as is the case also for the Telecommunication Research Institute of Ontario (TRIO), pursue either provincial or domestic objectives in terms of R&D but rather seek out that niche market internationally for telecommunication products which will focus on potential sales of a global nature.

The data determined that a national market structure MS$_2$ was most realistic but not necessarily the most preferable. Table 3.2 preferred.



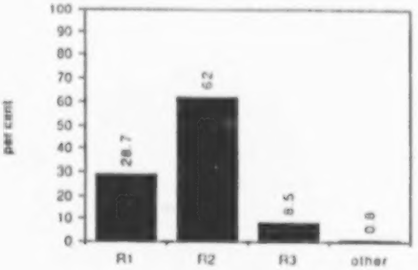
3. REGULATION

In terms of regulation three categories were utilized to construct the building blocks for possible future regulatory mechanisms.

1. Policy making
2. Competition
3. Pricing.

R$_1$ the fragmented regulation alternative it was assumed that piece-meal adhoc regulatory approach will continue. R$_2$ the systematic regulation block assumed national goals and priorities would guide decision making and that there would be increased competition along with rate rebalancing and market-based pricing. R$_3$ was a minimal regulation projection including more international (U.S. - Free Trade Agreement activities) and that global issues, standards and trends would effect the Canadian telecommunications industry to a very large extent.

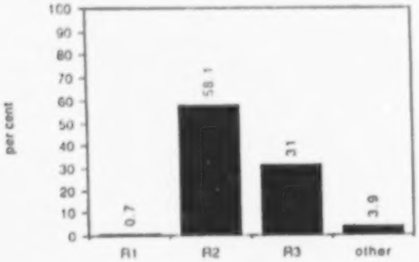
In terms of the responses (table 4.1, page 258) demonstrates that R_2 was by far the most preferred building block.



In terms of preferred regulation once again there was significant consensus that R_2 was the model to be followed with a significant number of thirty one per cent selecting R_3 visualizing more of a North American continental market place and regulatory consistency for industry.

An interesting finding in terms of regulation was that a number of regulators themselves saw less need for change and saw the status quo as being a workable model. By contrast the industry replies indicated a much stronger preference for some type of regulatory reform, particularly along a national model.

The Free Trade Agreement (FTA) will put pressure to harmonize telecommunication markets between the two countries and also to bring rates in line. By the end of the study period, an open and competitive continental marketplace will exist in the provision of services. Rate rebalancing and market-based pricing are anticipated. Survey results: Table 4.1 accurate, sixty two per cent selected R_2 (systematic regulation), R_1 selected by less, but fifty per cent of those were regulators. In terms of preferred future regulatory model, Table 4.2 preferred. Less than one percent say the continuation of status-quo as desirable. This reflects a high level of dissatisfaction with the adhoc and fragmented system of today.



The third area, Regulation, developed an interesting difference; namely, regulators, government officials, public utility boards, etc., found less pressure for change and also saw the maintenance of status-quo as not a bad option. This clearly differed from individuals replying from the industry itself. These individuals saw substantial pressure for change as well as a desire for legislative and regulatory changes.

CONCLUSIONS

Strategic Forecast:

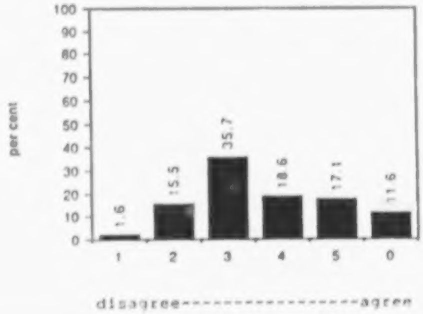
The most consensus model reflecting thirty per cent of the replies was for the following model. T_2, MS_2, R_2. Basically, a moderate evolutionary technology, national market structure with a federal regulatory framework was both perceived as the most accurate and the most preferred scenario.

T_2, MS_2, R_2. Evolutionary growth, national competition and systematic national regulation. This scenario sees introduction of new products and services, ISDN, HDTV, plus interactive fibre optic cable systems. More orderly policymaking at the federal level.

There is strong optimism that Canada will be a major player in the international telecommunication scene.

There were ten other areas reported in the data contained in Telecom 2001, but I will deal with only a few here.

On a sub-question, Canadian support for Japanese-like MITI was not extremely high, although in other areas the need for centralized and cooperative R&D and policy initiatives was quite apparent. This lack of support for MITI-type organization may reflect a frustration in dealing with federal communication officials and the federal regulator, i.e., CRTC, during the 1980s when there was little sophisticated policy movement. Table 6.9 MITI.



In the short run, this also appears likely to continue. DOC's call in September for comments on a duopoly of local services, e.g., telephone vs. cable, has raised a policy matter. Apparently the CRTC, a substantial player will not even comment. This reflects two solitudes and some of the bureaucratic in-fighting at the national level. This will require somewhat strong and forceful leadership which, to date, has been lacking.

Another point relates to the courts being the major impetus for technological change rather than regulatory agencies across North America. Both the FCC and the CRTC are not on the cutting edge of change, rather, in the U.S. it was Justice Harold Green and his consent decree which forced competition in the U.S. Currently, in Canada, it is the recent Supreme Court decision involving the AGT - CNCP case which, at least, provides the opportunity for the Federal government to provide for major telecommunication policy and a new telecommunications act which could go a long way to introduce a competitive national-level playing field for telecommunications.

One problem may be is whether the CRTC, which has been reluctant to encourage either competition, research or change, is up to the task. For example, the CRTC initially denied CNCP's application as a second long distance carrier in certain federally regulated markets.

A related issue is Northern Telecom controlling eighty five per cent of the Canadian market and having, in the United States, the opportunity to compete aggressively, particularly with AT&T and other telecom equipment suppliers. In return, AT&T and other suppliers are affectively closed out of the majority of the Canadian marketplace in terms of central switches, infrastructure equipment, etc. Given complaints in Washington, this may force changes in the Canadian scene not brought about by any type of dynamic or progressive vision of either DOC or the CRTC.

AGT and ILS

AGT, like Sask-Tel and Manitoba-Tel, is a crown corporation and has as its goal to provide customer service at the most affordable prices. It is not a profit making entity, and in fact, it is an ideal model to suit the public service mandate. It pays no dividends to the government and has used its funding, in part, to promote individual line service (ILS). This is an attempt to provide people in non-urban communities with individual line service so that they do not have the difficulties of a cumbersome party line service, but also, will have the opportunity to utilize more contemporary telecommunications attachment devices ranging from Fax to modems on home computers.

The ILS program reflects a commitment by the Province of Alberta and AGT to provide Albertans,particularly in remote and rural areas, with access to high quality telecommunication services at affordable prices. Potentially, 100,000 homes/businesses/farms currently served by multi-party telephone lines will be able, by 1991, to have individual line service. This is particularly significant because, as we realize, with modems and certain portable computer technology, ILS is mandatory. On a party line you simply cannot tie up your neighbour's line as you try to access remote databases or transfer information over telephone. The funding is a cooperative arrangement being shared among the provincial government, AGT and individual subscribers. About half of the 100,000 conversions have already taken place.

Although Telecom 2001: A Strategic Forecast indicates a strong need, from the data, for a federal or national policy, the recent AGT - CNCP Supreme Court decision clearly gives the federal government a strong handle in terms of legislative thrust.

One still has to ask, will CRTC's regulation be better?

In terms of AGT's ILS program, one wonders what the CRTC's reaction would have been. In addition, AGT as a crown corporation will now have to abide by the CRTC rules and regulations which are suited for economic hearings and profit making organizations, namely Bell Canada and BC Tel, and now the Maritime telecos. Finally, other provinces, particularly Saskatchewan, are adamant that they will not give up control or telephone companies.

NEW BILL

The telecommunications bill tabled on Thursday, October 19, 1989, seeks to correct a vacuum created by the recent AGT-CNCP Supreme Court decision; it is only a minor "housekeeping" bill and does not go far enough for two major reasons. First, it fails to address totally the situation of telecommunications control in Canada. For example, although it does include seven provincially-regulated telephone companies, there are a series of smaller telephone companies, some not so small, e.g., Edmonton Telephone and Quebec Telephone, plus some other one hundred small telephone companies, which are left out of the legislation. This is a major problem because some of these firms, of course, will not have to provide either access or reasonable rates for service as defined by either the Federal Government or by CRTC regulations. The second problem is that there is still no new national telecommunication policy or major bill. This is yet to be brought forward by DOC. When one considers the major issues confronting the telecommunication industry, whether it be competition in the provision of long distance service or competition in the provision of local services, it is extremely difficult for either the federal regulator or the industry itself to know what position to take or promote withreference to these two major sectors -- namely, local and long distance telephone service. With the duopoly comments being called for by DOC in January, 1990 plus any hearings on long distance competition having to be slated for 1990 or beyond, any new Bill in itself may not be appropriate in light of whatever decisions are made on these two major policy issues after it will be tabled in December.

Finally, the new policy one would have hoped would reflect adequate provincial and regional participation and dialogue but given the significantly hostile reaction of the particular three Western provinces to last week's announcement that this type of dialogue and cooperation is extremely remote on this major national telecommunications policy initiative slated for December.

RESEARCH AND DEVELOPMENT

Within the context of the overall report a major public policy problem relates to research and development funding. Let us not underestimate the importance of this matter, for the inability to properly fund R&D activities or to keep large R&D high tech firms is a major national problem, if not a tragedy. The sale of Connaught Bio Sciences Inc. is an excellent example. It is being hotly pursued by two foreign purchasers who will provide that type of international or global infrastructure to market the bio technology innovations and products produced.

The same problem may relate to several telecommunications firms in Canada. Yet what is the federal response? At the most recent meeting of federal provincial officials concerned with research and development, the federal government was extremely reluctant to agree to even the modest goal of increasing Canada's R&D spending to 2.5 per cent of gross domestic product by the year 2000. In fact, some may say this goal is too low. Yet, the federal government will not commit itself firmly to any commitment to reach that target. In fact, the junior Federal Minister of State for Science and Technology, William Winegard, is calling for more studies of R&D problems rather than making a commitment to a national research target.

This is a mistake on two counts. First, that only a junior Minister holds this portfolio, it obviously lacks clout around the Cabinet table or in the major policymaking cabinet sub-committees. Second, even high school students now know that there is a national need and problem. Yet, the Minister himself appears to be one of the few unconvinced of the major tragedy which is unfolding because of the failure of the federal government to recognize R&D as a national priority.

Even during the relatively difficult times of the 1980s the provinces' proportionate share of R&D has grown faster than federal commitments,despite the Prime Minister's rhetoric in the other direction. The lack of federal conviction and dollars means that the Canadian economy will remain resource-based, subject to the vicissitudes of the international resource markets, whether that be in wheat or oil.

There is a serious failing at the federal level to understand the role of R&D in general and the information revolution in particular. Much of the government attention on policy is designed to either prop up fading industrialized industries or engage in public policy confrontations such as on VIA Rail. The Federal Government is failing to address the implications for transportation, communication, R&D education, etc., for the 21st Century. The adhoc and fragmented nature of policymaking at the federal level clearly will not assist in promoting Canada's interest on the international scale, particularly when one considers that we are essentially competing against, in the short run, three major groups; namely, Europe, the United States, and, Japan. By the turn of the century there will be an added fourth, namely, Asia, which will not only provide extensive opportunities for Canadian exports but will also provide substantial competition for Canadian firms around the world.

Let me close by saying that I am basically optimistic for two reasons.

First, there are Canadian success stories ranging from I.P. Sharp, Glenayre, C.A.E. Industries, Telesat, Spar, Novatel, S.C.M. and Northern Telecom. We also enjoy significant international prestige in the telecommunications area.

Second, our national study and my own interviews with senior corporate officials in the communications industry provides me with hope since their ability, enthusiasm and understanding of the corporate dimensions reflect the type of leadership needed to propel many Canadian high technology businesses into an aggressive global marketplace. Canadian firms and talent will hold their own for the most part during the 1990s.

Finally, more and more individuals are beginning to not only understand the dimensions of the problem, but they are beginning and willing to speak out. In the 21st Century the choice for Canada is quite clear. Either we become a modern information-based economy with all that that implies or we become atechnological serf or colony of some other nation state. Where Canada will be in the 21st Century will not be a function of decisions made in the year 2000 but will be a function of the decision made within the next few years. That is why I find it such an exciting time to be engaged as a researcher and policy analyst in this area.

SUMMARY

The preceding represents a case study involving the crucial area of telecommunications. Although the data is from Canadian sources there are implication for other Nation States, particularly those of a middle power status. As the the 21st Century rapidly approaches, many nations are evolving into information-based economies. But with this change in structure is coming a parallel awareness of public policy issues and concerns. Clearly there will be a number of net winners, but the net losers could become technological serfs of other nation states, particularly if they lose control over both hardware and software aspects of the information revolution. Although Canada clearly has not solved all it's problems, it does have significant players in the information sector along with strong commitment on behalf of regional and federal governments to assist Canada in playing a major role, both domestically and internationally, in the communication field.

Two Solitudes: Bridging the Gap between Telecommunications Planning and Regional Development Planning

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1. Abstract

This paper analyzes innovative strategies and techniques intended to promote investment in telecommunications facilities to support regional development. The paper examines several models that have been adopted by U.S. states, Canadian provinces, and other countries to attempt to relate telecommunications planning and investment to regional development goals.

2. Telecommunications and The New Rural Economy

The structure of industrialized economies is changing, with services now the most rapidly growing sector. This structural shift is mirrored in rural economies, where public and private services now generally dwarf agriculture and manufacturing. Both urban and rural industries are being drawn more and more into the global economy.

Yet the shift to services is only part of the change. In the U.S., information-based activities account for the largest part of the growth in services, and other sectors are becoming increasingly information intensive. Manufacturers must now be able to respond to changes in demand; suppliers must be able to produce small orders for quick delivery; merchants must be able to update inventory and accounts records instantly. To stay internationally competitive, farmers also must resort to increased specialization, and react to shifts in consumer demand.

The telecommunications environment has also changed dramatically. Technologies such as satellites, optical fiber, cellular radio and digital microwave have been introduced, and the convergence of computers and telecommunications has turned the telephone networks into information highways. In the U.S., the telecommunications regulatory environment has also changed. The introduction of competition in equipment and value-added services and the divestiture of AT&T have resulted in new choices for consumers. They have also disaggregated the networks in ways that were not foreseen by the regulators of telephone company monopolies who authorized internal cross subsidies to enable the telephone companies to serve rural areas. Other countries are introducing varying approaches to privatization and/or competition that may have similar effects, although on a different scale.

2.1 Specialization and Diversification

While agriculture still represents the biggest structural difference between rural and urban economies, farming in the U.S. employs only nine percent of all rural workers and only half as many workers as manufacturing. Both farming and manufacturing are dwarfed by the private and public services sector; in this sense rural and urban economies are more alike than different. Rural services are dominated by wholesale and retail trade, other private services, and government (most significantly, local school systems.).

Yet the rates at which this trend has occurred in rural and urban economies are quite different. Rural areas in the U.S. lost goods-producing jobs at more than twice the urban rate between 1979 and 1986, and their rate of service sector growth was only two-thirds that of urban areas. Thus even as rural economies become more dependent on services, they lag behind urban economies in their ability to exploit a national economic trend. (Parker et al., 1989)

Sequential specialization has been the chief process by which rural communities developed economically in the postwar era. Too small to diversify their economic bases, rural towns have moved from one economic specialty to another, as natural resource--based industries declined. The overall result was greater diversity among rural areas, but continued dependence on a few major employers in a small number of closely related industries. The extent of economic specialization, and the different geographic patterns of specialization are illustrated in the maps showing rural counties dependent on farming, mining and manufacturing.

3. The Rural Penalty

3.1 Distance

Distance represents time, in an increasingly time-conscious world. In a manufacturing environment that increasingly depends upon out-sourcing of component parts and just-in-time delivery to assembly plants, the further a rural community is located from a metropolitan area, the more some other economic characteristic (for example, lower wages) must compensate for the time/-distance problem. In an economy that depended greatly upon the extraction of resources (lumber and minerals) and farming of agricultural land, which were mostly located in rural areas, the rural penalty was a necessary consequence of being rural. In today's service-oriented economy, which increasingly depends upon information as a resource (or input) to produce a product which in itself may simply be a repackaging of information into a form with greater value, there is no inherent reason why a consumer or business must pay a distance penalty.

3.2 Economic Specialization

A second aspect of the rural penalty is the economic specialization of rural communities. Typically rural communities lack the diversification that large size makes plausible. Few communities have an even balance of farming, manufacturing, or government installations. An approach to rural development that focuses on only one industry, one type of quality of life deficit, or one type of employment problem (such as underemployment), would in fact leave most of rural America untouched. Thus, from the standpoint of how telecommunications policy can influence rural development opportunities, it is important to identify the telecommunications dependencies of many types of industries, from agriculture to services, and multiple quality of life concerns, from medical care to education.

3.3 Overcoming the Rural Penalty

Historically, rural development took place where there was geographic advantage in the form of arable land or natural resources. Increasingly, new economic development depends on human resources and telecommunications and information-processing infrastructure. In the provision of physical goods and services, rural areas could only compete across barriers of distance and geography if they had a natural resource advantage. In the provision of information goods and services, reliable telecommunications infrastructure can make geography and distance irrelevant.

4. Telecommunications and Rural Development

4.1. Indirect Benefits of Telecommunications

How do telecommunications technologies contribute to the rural development process? Access to information is key to a wide range of rural activities including agriculture, manufacturing, transportation, education, health care and social services. Instantaneous communication can help improve *efficiency*, or the ratio of output to cost; *effectiveness*, or the quality of products and services; and *equity*, or the distribution of benefits throughout the society.

4.2 Telecommunications as a Complement in Rural Development

Research during the past decade has shown that telecommunications can contribute significantly to socio-economic development (see Hardy, 1980; Saunders et al., 1983; Hudson, 1984; ITU, 1986). However, many other factors may influence whether and to what extent telecommunications may make an impact. Generally, certain levels of other basic infrastructure as well as organizational activity are required for the indirect benefits of telecommunications to be realized. For example, a well managed decentralized organization such as a manufacturing enterprise, a tourist development, or a health service will derive more benefits from telecommunications than a poorly managed or understaffed operation. Telecommunications may also serve as a catalyst at certain stages of the rural development process, becoming particularly important when other innovations are introduced such as improved farming practices, lines of credit, incentives for decentralization and diversification of the rural economic base.

5. The Impetus for Integrated Planning

For many years, the call to integrate telecommunications planning with other forms of regional planning went largely unheeded. But recently there has been a surge of interest in the role of telecommunications in development, particularly in rural areas. Several factors may contribute to this heightened visibility:

Changes in rural economies: As noted above, the rural economy in the U.S.has undergone wrenching changes in the past decade. Politicians and planners are seeking new strategies to revitalize and diversify rural economies. Similar trends are found in Canada and western Europe.

Changing rural technologies: The availability of new technologies such as cellular radio, other forms of radio (e.g. BETRS), small satellite earth stations, lower power consumption amenable to solar and wind generation, and small digital switches, etc. has made provision of basic service and upgrading of services plausible in areas were previously considered too difficult or uneconomical to serve.

Converging technologies: The convergence of telecommunications and information technologies is resulting in a proliferation of new services. Facsimile is becoming a standard business tool. Computer communications in the form of access to data bases, electronic mail networks, videotext services, etc. are expanding dramatically. Thus the goal of "universal information service" is updating the earlier goal of universal basic service.

Changes in the regulatory environment: Regulatory agencies are looking for models to replace rate base regulation. Similarly, the telephone industry is seeking alternatives that will give it more flexibility in price setting and investment. Some telephone companies are proposing rapid upgrading of facilities to enhance regional development as a quid pro quo for reduced regulation.

6. Organizational Structure: Who is Responsible for Telecommunications Policy?

One approach to analyzing the relationship of telecommunications policy to other policy goals is to examine the institutional responsibility for telecommunications. The following is an overview of several institutional structures.

Regulatory agency: At the state level in the U.S., the Public Utilities Commission is generally responsible for regulating intrastate telecommunications. Often, the PUC is the de facto policy making agency, by responding to price and investment issues raised by the carriers it regulates.

Legislature: Policies can also be made or modified by enacting legislation. In the U.S., the Congressional committees primarily responsible for telecommunications are the House Subcommittee on Telecommunications and Finance and the Senate Subcommittee on Communications. At the state level, there may also be standing committees with responsibility for telecommunications, such as, for example, California's Assembly Committee on Utilities and Commerce. In other jurisdictions, there may be no legislative unit with responsibility for telecommunications.

Executive: Telecommunications policy may occasionally be institutionalized at the executive level. For example, North Carolina has an Office of Telecommunications in the governor's office, as did Alaska during the 1970's. At the federal level, the Office of Telecommunications Policy, located in the White House during the Nixon administration, was abolished by the Carter administration, which in turn established the National Telecommunications and Information Administration in the Department of Commerce.

Government department: Telecommunications may be the responsibility of a separate department, or shared with other jurisdictions. An example of the specialized agency approach is Canada's Department of Communications (DOC). Australia has a very similar DOC. In some countries, telecommunications is linked with transportation, in others with industry or commerce, such as the NTIA within Commerce in the U.S., and the United Kingdom's Ministry of Trade and Industry.

However, government agencies, particularly at the state level, may have responsibility only for their government's own telecommunications requirements, rather than for state residents as a whole. Some states may place telecommunications in a Department of Administration (e.g. Alaska); others may place telecommunications with other functions such as education.

PTT: In Europe, and in other countries following the European model, responsibility for telecommunications has rested with the Ministry of Posts, Telegraphs and Telecommunications (PTT). There typically has not been a separate agency for regulation or oversight, although one may have been created if the sector has undergone privatization or other restructuring (e.g. OFTEL in the UK; AUSTEL in Australia.) In other cases, the carrier itself is left with sole responsibility for planning and investment (e.g. Televerket in Sweden).

7. Models for Integrating Telecommunications Planning and Policy with Regional Development Planning

The institutional structure may set the parameters for planning or policy. However, the mandates may vary, even among countries or states that use similar institutional structures. Thus, it is also necessary to examine various approaches to planning and policy that cut across institutions. The following are several models for integrating telecommunications planning and/or policy with development goals and activities.

7.1. Integrated Planning

Where telecommunications services and regional development are both government responsibilities, a coordinated plan may be proposed to enable infrastructure investment and new services to support development goals.

Examples:

European Community (EC): The EC is placing increasing emphasis on an overall strategy for technological research, cooperation and innovation. One of the areas identified is "Information and Telecommunications Technologies." Members of the EC have targeted telecommunications as a vital strategic resource for European economic growth. They see telecommunications as part of both an industrial strategy to develop products for global markets but also an economic strategy for the expansion of the European economy.

In its Framework Program for 1987-1991, the EC includes several information technology and telecommunications projects designed both to stimulate market growth in new technologies and services and to move toward an "information and telecommunications society." These projects promote cooperative activities by joint financing between the EC, individual governments and industry, and contracting out research to specialist agencies. (Ungerer, 1988)

South Korea: The government of South Korea has targeted telecommunications and information technologies as part of its industrial and socio-economic strategies. South Korea has not only become a major exporter of electronic equipment, but it has also set ambitious domestic goals for these technologies. It achieved its goal of one television per household in the early 1980's, and has now reached the goal of an average of one telephone per household. It aims for an average penetration of one personal computer per household by the late 1990's. (Mok, 1989)

7.2. Basic infrastructure support

Governments underwrite all or part of the cost of installing and upgrading telecommunications facilities in unprofitable areas. Such investment is generally made with the assumption that improved access to telecommunications will contribute to social and/or economic goals such as reducing disparities in access to services between rural and urban residents, or fostering economic development. It is further assumed that the areas to be served are sufficiently unattractive to the carriers that funding for capital investment must be provided by the government.

Examples:

Alaska: In 1976, the state of Alaska appropriated $5 million for the purchase of 125 satellite earth stations to provide basic telephone service to Alaskan villages. The earth stations were installed and operated by the Alascom, the intrastate carrier.

Rural Electrification Administration (REA): The REA is part of the U.S. Department of Agriculture, reflecting the New Deal commitment to providing utilities in rural areas to improve rural quality of life. REA provides low cost loans to rural telephone companies for installation and upgrading of facilities.

STAR: The European Community's STAR program is designed to develop telecommunications infrastructure and networks in underdeveloped, primarily rural, regions of the Community. Despite the fact that the members of the EC are primarily highly industrialized countries, many contain regions that are economically disadvantaged. In addition, approximately fifty percent of the Community's population live in rural areas. STAR is intended to aid infrastructure investment in these regions, as well as to carry out trials and demonstrations of new technologies and services that could contribute to their socio-economic development. Regions included are Ireland, Northern Ireland, Corsica and the overseas departments of France, and large areas of southern Italy, Spain, Greece, and Portugal. Approximately $750 million is to be spent on STAR projects. (Ungerer, 1988)

7.3. State or Regional Government Initiatives

State governments identify requirements for upgrades and new services to support economic development, and propose initiatives to introduce these innovations.

Examples:

Maine: The state of Maine has introduced statewide 911 service as part of its commitment to providing universal access to emergency services. It has also negotiated with the carriers to provide free access to rights of way along its freeways for installation of optical fiber, as an incentive for extension of fiber to smaller cities and towns.

Hawaii: The state of Hawaii has also embarked on a program to upgrade telecommunications facilities in rural areas of the islands as a stimulus for economic development.

Alberta and Saskatchewan: These Canadian provinces have both implemented programs to upgrade all rural telephone service from multiline to single line service. Both provincial governments state that the projects reflect their goals of reducing disparities between rural and urban residents and providing rural access to new technologies and services. In both cases, the telephone services are operated by a provincial government entity, Alberta Government Telephones (AGT) and SaskTel.

7.4. Identifying Needs and Testing Solutions

Pilot projects: Government agencies support innovative projects designed to test the suitability of new technologies for development applications. Pilot projects and demonstrations provide an opportunity to evaluate the technical performance and applications of new technologies and services, or to test existing facilities in new environments.

Examples:

ATS and CTS: In North America during the 1970's experimental satellites including the Applied Technology series (ATS-1, ATS-3, ATS-6) and CTS (the joint U.S.-Canadian Communication Technology Satellite) provided opportunities to test satellite-delivered health and education applications in rural areas.

AID Rural Satellite Program: In developing countries, the U.S. Agency for International Development's (AID) Rural Satellite Program sponsored pilot projects using existing satellites to provide health and education services in rural areas of Indonesia and Peru, and to link university campuses and extension centers in the West Indies.

ESPRIT (EC): ESPRIT is a ten year EC program comprising a pilot phase, a five year program for phase 1, and a four year program for phase 2. The research covers the fields of information technology, the automation of office work and production processes (robotics), and telecommunications. The program cost for the first five year period (1984-89) was approximately $1.5 billion, half of which was provided by the Community, and half by industry. Some 201 projects were approved during this period.

RACE (EC): RACE is a Community research and development program in telecommunications technologies. The goal of RACE is to make a major contribution to the introduction of integrated broadband communications, taking into account the evolving ISDN and national introduction strategies, and progressing to Community-wide services by 1995. Through these activities, RACE is intended to help make telecommunications the leading economic sector in Europe by 1995. The budget for the main phase of the project (1987-1992) is approximately $550 million, shared equally between the Community and the participants. (Ungerer, 1988)

Telecottages: The Swedish government has funded a number of "telecottages", rural sites with computer and telecommunications facilities that are used by community residents. Some are strictly educational; others have spawned small businesses. The project is part of a program called "Let All Sweden Live" which is intended to create social and economic incentives for people to live in rural Sweden. Telecottages are also found in other Scandinavian countries.

7.5. Studies

Studies may be undertaken by specialized agencies or individuals representing a cross section of the society to determine how new technologies an services might meet their needs.

Examples:

National Level Studies: At the national level, several countries have carried out studies examining the potential role of telecommunications and information technologies, and recommending strategies for development and application of new technologies and services. Several such studies were carried out in the 1970's, the best known of which is France's Nora/Minc report (The Informaticization of Society). Canada and Australia also both conducted extensive studies. More recently, the U.S. National Telecommunications and Information Administration published Telecom 2000, providing an overview of trends in technology and services and recommended goals for access to new services.

State level studies: Several studies have recently examined telecommunications technologies and priorities at the state level, for example:

California: The Intelligent Network Task Force, sponsored by Pacific Bell, brought together individuals representing California's diverse ethnic and public service constituencies.
The group prepared a report explaining how new telecommunications technologies and services could benefit California, and recommending widespread access to new services.

Washington: A "Telecommunications Task Force" with members drawn from GTE Northwest, US Sprint, and Global Telematics examined future options for Washington State, with input from consumers, academics, and government examined future telecommunications services and potential benefits for the state of Washington.

Minnesota: An Interagency Task Force with representatives from several state government departments and agencies and input from consumers and other interested parties has examined options for the introduction and extension of new telecommunications services throughout Minnesota.

7.6. Economic Incentives:

Cross subsidies: Generally, provision of services in rural areas is cross-subsidized by profitable services such as interurban links. Again, the assumption is that it is important for policy reasons to provide services in rural areas where distance and lower population densities may make services unprofitable. In public monopolies, these subsidies may be hidden in the general tariff structure. In private regulated monopolies internal cross subsidies are generally allowed as the prime means of covering the costs of rural services. Typically, the monopoly carrier is required to provide services to an entire region (e.g. state or province) as part of its franchise.

Special Subsidies: In a competitive environment subsidies must be separately accounted for, so that monopoly services are not used to subsidize competitive services.

Example:

Universal Service Fund: In the U.S., to further the goal of universal service, the Federal Communications Commission (FCC) has authorized a special universal service fund paid from a portion of pooled long distance revenues. The funds are allocated to particularly high cost areas to keep rates affordable for rural subscribers.

Aggregating small users: Rural areas often lack economies of scale that would make provision of new services attractive. Small telephone companies may aggregate their traffic to provide sufficient demand to attract new services.

Example:

Iowa Network Services (INS): Iowa Network Services is a consortium of small telephone companies in Iowa that have joined together to build a fiber network to deliver their traffic to a Point of Presence (POP) where the traffic can be picked up by long distance carriers. INS made this investment to attract additional long distance carriers and to provide an attractive market for other new services.

7.7. Regulatory Incentives

"Social contract:" Regulators, telephone companies, and representatives of users including businesses, social services, and residents agree on policies designed to upgrade services, maintain affordable access, and provide flexibility to the telephone carriers.

Example:

Vermont: In December 1988, the Vermont Public Service Board approved a five-year agreement with New England Telephone that substantially altered the regulatory framework in Vermont. The Vermont Telecommunications Agreement (VTA) is not total deregulation nor a rate case settlement, but an attempt to modify the regulatory approach to respond to both cost and competitive pressures. A social contract model was adopted, requiring the building of consensus among the state government agencies, consumer representatives, the carrier, and other interested parties. The goal of the social contract was to stabilize rates for basic exchange service and set minimum service quality and modernization criteria for consumers, in exchange for relief from rate of return regulation and greater marketing flexibility for the local exchange carrier. Vermont views this approach as a controlled experiment because the agreement is continually monitored and can be renegotiated, and because the enabling statute sunsets in 1992. Any extension of the contract will have to be renegotiated. (Rude, 1989)

Pro-active regulation: Rather than waiting to react to industry proposals through regulation, some regulatory bodies are taking initiatives to implement policies designed to foster economic development.

Examples:

New York: The New York Public Service Commission has proposed legislation that will provide both quality of service incentives and pricing incentives to its regulated telecommunications carriers. New York was also the first state to introduce incentive regulation (see below) in 1986. The New York Commission sees its role as initiating policies and proposing legislation, rather than simply responding to issues raised in rate cases. (Noam, 1989)

Pricing Flexibility with Conditions: Several states have introduced changes in regulation that allow the carriers considerable pricing flexibility in return for meeting certain conditions. Vermont was discussed above. Some states have adopted price caps, which replace rate of return regulation with caps on pricing tied to the rate of inflation. Typically, the carrier has considerable pricing flexibility within a range, and must share profits above a certain threshold with its customers.

Examples:

California: The California Public Utilities Commission (PUC) has approved an incentive regulation structure for Pacific Bell and GTE California that will peg prices of the carriers' monopoly services to a productivity-based inflation index.

Wisconsin: Wisconsin adopted an incentive plan for Wisconsin Bell in 1987, which split 50/50 any earnings between 14 percent and 15.5 percent return on equity, with anything over 15.5% returned to ratepayers.

Other states considering a version of incentive regulation include Illinois, Michigan, Oregon and Texas. (State ... Report, 1989)

8. Conclusion

Telecommunications planning and regional development planning in the past have tended to be "two solitudes." However, the importance of access to information for economic development activities and social service delivery now point to the need to bridge the gap between these disciplines and responsibilities. There is also a need for broad-based participation from various constituencies including legislators, regulators, state government agencies, carriers, and users including large and small businesses and residential customers from both rural and urban areas.

No one approach is likely to be suitable for all, given the variety of policy, regulatory, and industrial contexts. However, the above models provide useful insights on various approaches to integrated planning.

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Who's Holding the Phone? Policy Issues in an Age of Transnational Communications Enterprises

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1. ABSTRACT

It was presumed just a few years ago that the expansion of existing services and the introduction of new services in most countries would be accomplished by national telecommunications authorities. The increasing trend towards regulatory liberalization has created a new breed of transnational telecommunications enterprise and opened some doors for them that would have been closed previously. However, policymakers will find it increasingly important to review their laws and regulations governing the participation of foreign-based enterprises in their domestic telecommunications markets. Their initial reactions, moreover, may not be the correct ones.

2.0 The Old Assumptions

2.1 The "Year of . . ."

If anything, 1989 should be known for the rest of history as the year in which the Old Assumptions died. On the global scene, the Old Assumptions about the basic outline of international relations were shattered. Analysts and academics in international relations are still trying to open up their minds and to start "to think about the unthinkable" -- formerly a eurphemism implying nuclear holocaust, but which now may mean the complete opposite.

The same has been true in telecommunications. Old Assumptions have been dying at a rapid rate and the half-lives of New Assumptions seems to be measured in months, rather than years.

One such Old Assumption, which seems to have undergirded thinking from the highest level, such as the International Telecommunication Union, has been that in most countries the domestic telecommunications authorities -- in other words, the PTTs -- would be the ones to expand existing services and introduce new ones.

Smaller countries assumed, as part of this scenario, that the entity to whom they had long ago awarded the franchise to provide either domestic or international telecommunications services and facilities for their countries, or both, would continue to be their provider. There was little or no choice. The only question was under what terms and conditions the franchise would be renewed.

A second Old Assumption, a favorite of academics particularly, has been that telecommunications and the media will merge. People in the telecommunications business tended to think that, if this really happened, they would remain in charge.

Both assumptions need to be reexamined as we start the 1990s.

2.2 A Reality Check

Events began overtaking the first assumption a few years ago. The public and policymakers realized that the local PTT would not necessarily introduce new services at an expeditious pace for two primary reasons. First, the national operator often did not have the expertise or the funds (perhaps because profits were being drained off by the government to subsidize other social services) to do so. Alternatively, it was disinclined to rush new technology into the marketplace where it might make obsolescent embedded investments.

Suddenly, some PTTs and other entrenched operators began finding new entrants being allowed to introduce the new services that they had not. Many of these new entrants were foreign-based, but they were not the foreign manufacturers and consultants that had helped the PTT in the past. Instead, these foreign companies bore names that were familiar to the PTTs as correspondents for international traffic, or else as recent offspring from these organizations. The names, as many here know -- and even bear -- were British Telecom International, AT&T, and subsidiaries of the U.S. Regional Bell Operating Companies (RBOCs): Ameritech, Bell Atlantic, BellSouth, NYNEX, Pacific Telesis, Southwestern Bell, and U.S. West.

A few recent examples demonstrate the point. Last summer in Hong Kong, a consortium including U.S. West won the right to build a cable television distribution system in Hong Kong. Its primary competition had come from a consortium that included a British Telecom subsidiary. Both consortia were nominally under the control of local interests, but had brought in the foreign equity partners for their financial strength and technical expertise. In Japan, one of the two new international telecommunications services suppliers, International Digital Communications (IDC), is partly owned by Pacific Telesis

International and Cable & Wireless. Ironically, Cable & Wireless figures in the above example as well. It is the telecom operator in Hong Kong which potentially could face indirect -- if not direct -- competition in the future from the new cable television franchisee.

Moreover, last month the West German Government awarded a second cellular communications license to a consortium whose significant foreign partners are Pacific Telesis International and Cable & Wireless. Other consortia bidding -- and there were ten altogether -- included virtually all of the RBOCs, plus the two largest non-Bell telephone holding companies in the U.S., Contel and GTE. (U.S. West skipped over West Germany and instead signed a deal with the Hungarian PTT to build a cellular telephone system in that country.) McCaw Cellular was also involved in one of the German consortia, as were companies from France, Italy, the U.K. and, of course, Germany. The group that won was headed by Mannesmann.

Finally, almost simultaneously with the cellular award in Germany, the British Government announced that it would award licenses to provide Personal Communications Network services to three consortia. Their composition is illustrative of the rapidly proliferating cast of characters on the international telecommunications stage. One winning franchise was led by British Aerospace, but included Pacific Telesis International, Matra Communications of France, and Millicom of U.K., a subsidiary of Millicom if the U.S., with Sony ready to join. Another license was awarded to a group composed of STC of the U.K. (better known at this conference as a builder of undersea cables), U.S. West, Thorn-EMI, and the Deutsche Bundespost Telekom. The third PCN licensee is a consortium led by Cable & Wireless' Mercury subsidiary. It includes such well-known foreign organizations as Motorola and Telefonica of Spain.

The United States has seen a significant influx of new foreign investment, principally British, in the last few years, as well. Having already acquired Dialcom, the enhanced services provider, in 1986, British Telecom in 1989 also purchased Tymnet, a data communications services provider. In addition, BT took a 22 percent interest in the largest U.S. cellular operator, McCaw Cellular Communications last year. BT also owns 51 percent of Mitel, a Canadian-U.S. vendor of PBXs, and has interests in voice mail and paging firms located on the U.S. West Coast. Cable & Wireless has had a number of subsidiaries for some time operating in the United States, as well.

In fact, Cable & Wireless is unique in today's telecommunications environment. In a sense, it is the quintessential example of the "Old Guard" in telecommunications. Its origins can be traced back more than 120 years to the earliest undersea telegraph cable ventures. It evolved and grew into the cable and short wave radio operator for the British Empire. Before and after the Empire receded, Cable & Wireless found another niche as the domestic and international telecommunications franchise holder in many colonies and former colonies. In recent years, it has responded to openings in new areas by aggressively pursuing additional franchises to offer new services or to assist in the creation of new operators offering competitive services. As such, it has undoubtedly served as an example for other telecommunications organizations who have been taking their first steps into the international arena recently.

2.3 Merger Still Pending

The merger of the media into telecommunications (or vice versa, if you prefer) in a technical sense has begun to happen. Wideband satellite and fiber optic capacity, both within and between countries, plus the Integrated Services Digital Network concept, is fostering the melding of sound, text, and visual images. In another sense, however, the merger has not yet happened -- but it may start to happen soon. A true merger of media and telecommunications would, in a business sense, see the major players in both arenas actually merging their businesses. This has not yet happened, but we may see it in the next few years.

At the moment, the media industry is in the process of rapid horizontal and vertical integration along international lines. Despite rules in several countries meant to discourage cross-media ownership (i.e., the same organization owning newspapers and television stations, for example), such cross-media ownership is becoming more common, rather than less. It encompasses everything from book publishing to record and movie production, television and radio broadcasting, cable television, newspapers and magazines. The names of the companies involved in these ventures are familiar as well in many countries: Maxwell Communications, Bond Corp., Rupert Murdoch's News Corporation, Silvio Berlusconi's Fininvest, and Time-Warner of the U.S.

So far, however, these companies have not crossed over generally into classic telecommunications services. An exception is Bond Corp.'s purchase of the Chile Telephone Company. There are several reasons for this. Such crossovers have not occurred because the media giants have commonly grown up in countries either where the local telecommunications monopoly has been all but unassailable -- at least until now -- or else where there were significant regulatory barriers designed to keep the "conduit" separate from the "information".

One place where the two sides have started to come together is in satellite communications. GE American Communications and HBO, the cable television programming arm of Time, formed a joint venture called Crimson, in an effort to develop the direct-to-home satellite television market. The effort was unsuccessful.

Perhaps more indicative of the way that the fortunes of the global media and the telecommunications services providers are becoming intertwined is the case of SES. SES, a Luxembourg-based regional satellite television company, operates the Astra satellite. At the moment its fortunes seem closely intertwined with that of Rupert Murdoch's Sky TV venture, its biggest active customer.

Once these giant customers become so large that their decisions can determine the fate of a telecommunications services supplier like a satellite company, then the balance of power between the customer and the service supplier will have become irrevocably linked. Moreover, the media giants are developing in-house telecommunications expertise as they enlarge. Regulatory liberalization in their major markets is and will in the future permit them to gain more experience, especially in the fields of satellite and cable distribution of information and enhanced or value added services.

So far, however, no media giant has launched its own satellite systems or taken over a major telecommunications services provider. Nor has the reverse happened. In all probability, we will see more joint ventures between foreign-based and domestic telecommunications services providers and their former subservient customers. As time passes, the probability will also increase that we will see a merger of a media giant and a telecom services supplier proposed that will challenge at least some policymakers long-held assumption that the "conduit" should be separated from the "information". It is not my intention to address this issue here, though it is well worth thorough examination.

3.0 Reasons for the Increasing Transnationalization

3.1 Definition

Researchers at the East-West Communications Institute (now known as the Culture and Communications Institute) in the early 1980s held a conference to discuss the emergence of Transnational Communications Enterprises (TNCEs). The term was coined to describe companies who keep their roots in a particular country, but who venture overseas in the communications business. (If they had lost their national identities along the way, "Multinational Communications Enterprises" would be the more appropriate term.) At the time, most of the TNCEs were in what I have called the global media business, but the term was meant to encompass all sorts of communications enterprises. The use of the term "enterprise" might have unknowingly been the most telling, since the privatization of former PTTs has seemed to have been one of several reasons for the emergence of telecom-based TNCEs in the last few years.

3.2 Emergence of TNCEs

What has contributed to the emergence of the TNCEs? The reasons for the appearance of the media-based TNCEs is relatively simple. Many of these media companies started with a powerful base in their homelands, if not a dominant position in at least some sectors. Reaching either the economic or legal limits of growth domestically, they naturally looked for opportunities in familiar fields in foreign markets. Sometimes this has taken them very far afield. A recent story about Maxwell Communications' plans for a "popular press"-type of newspaper in Japan noted that the company has "footholds" in 26 countries.

The emergence of the telecom-based TNCEs is more recent, but the reasons also seem obvious. An unintended side effect of telecommunications liberalization in many countries has been the creation of opportunities for foreign-based firms to participate for the first time in the domestic markets. In addition, incentives are created in the process for the previous monopoly PTT to seek opportunities for itself elsewhere.

3.3 BT's Transformation

British Telecom was perhaps the first TNCE born in the modern era. BT's moves into foreign markets followed several significant events in its history. As a result of major telecommunications laws enacted in 1981 and 1984, BT was separated from the Post Office, and 50.2 percent of its shares sold to the public in 1984. Thus, it no longer had to carry the baggage of being a government-owned company as it moved overseas. In addition, as a result of the 1981 Telecommunications Act, Cable & Wireless' subsidiary Mercury was licensed to compete with BT for the provision of domestic and international telecommunications services. With its main sources of revenue in potential jeopardy and privatization and competition engendering a requirement to rejuvenate the company, BT naturally looked overseas for opportunities. Its investments overseas to date seem to have been largely in areas in which it is familiar: cable television, mobile communications and supply of telecommunications equipment. Moreover, its longstanding relationships as an international correspondent gave it entry into diverse markets in North America, Asia, Europe and even the South Pacific.

3.3 PTT Objectives

As competition is introduced into various segments of the telecommunications markets of more countries, one can expect to see more former PTTs looking for new sources of revenues. These sources are genreally likely to be in areas with which they are familiar. But, since the PTTs were often slow to implement new services and technologies domestically, they can be expected to invest in technologies and services overseas with which they are not familiar. Their objective will be to learn from these investments and then to bring that expertise back home -- if some foreign TNCE has not already "poached" on their territory. Because the danger of such "poaching" -- created by rapid liberalization in PTTs' home markets -- will be so great, the former PTTs will have to become adept at quickly turning their overseas investments and experience into opportunities for reverse technology and knowledge transfer.

There is already evidence that this is happening. As noted earlier, the Deutsche Bundespost Telekom is in one of the consortia in the U.K. which has been granted a PCN license, while in its home market a cellular license has just been awarded to a group that will compete against Telekom's existing cellular service. PCN is seen as both a competitive and complementary service to cellular communications. No doubt Telekom will seek to learn quickly from its involvement in the U.K., so that it can seek to convince policymakers back in Germany to allow it to introduce the service there, as well.

The other European PTTs and PTTs elsewhere in the world are no doubt following these examples closely in preparation for the day when they too will find their monopolies ended and their future revenues at issue. Some are even trying to put a brave front forward. A spokesman for the French PTT has written that his countrymen look forward to the changes that will be brought about by the European Community's overall EC 92 program. His carefully worded phrasing left one to wonder, however, whether that sentiment was felt by his organization, in particular.

3.4 RBOC Transnationals

The motivations of the RBOCs, who were very similar in circumstance to the pre-liberalized PTTs, are somewhat more complex. The Modified Final Judgement (MFJ) which ended the U.S. Government's antitrust case against AT&T, left the RBOCs in 1984 in possession of their local distribution systems and not much else. Their local distribution monopolies were immediately placed under some measure of challenge by various types of "bypass", wherein large business customers and long distance carriers sought to avoid the local distribution system and interconnect internally or with each other directly. In addition, fiber optic metropolitan area networks (MANs) have been implemented in several major U.S. cities, giving business users alternatives for communications within the area.

More importantly, perhaps, the RBOCs were prohibited from entering into domestic long distance service or manufacturing. A ban on their involvement in the provision of information services has been lifted somewhat, though not much. Now, they can provide "gateways" for information services provided by others. Rules established before the MFJ was put into place also keep telephone companies out of the provision of cable television services, though in some limited circumstances American telephone companies can provide the facilities to others who provide the programming and sell it to the public. Outside of basic local services, however, the RBOCs were largely only permitted to enter into such major new telecom service areas as cellular and paging.
However, all of these prohibitions are under legal and political challenge. The common belief is that sooner or later the RBOCs will be permitted into many of these areas, starting perhaps with manufacturing, information services, and maybe cable television.

The RBOCs have succeeded in convincing Judge Harold Green, who oversees the implementation of the MFJ, to permit them to enter into a wide variety of overseas ventures under certain circumstances. Conditions placed on Pacific Telesis, one of the most active RBOCs overseas, are illustrative:

- Involvement must be through a subsidiary separated from the company's telephone operating group in the U.S.

- The foreign operating subsidiaries must raise their own debt in such a way as to preclude a creditor from having recourse to the stock or assets of any U.S. telephone operating group.

- The total net revenue from all activities for which the company has had to seek special permission from the judge in order to participate, including overseas efforts, cannot exceed 10 percent of the company's total estimated net revenues. This proviso is meant to ensure that the RBOCs do not lose their focus on their primary business, providing basic telecommunications service in their home regions. Since the annual revenues of the companies averages between $9 and $14 billion, however, they have considerable latitude for foreign investment.

- Telecommunications services and products provided through the RBOC's foreign ventures must be sold strictly outside of the United States; and no traffic can originate or terminate in the U.S.

- If a foreign subsidiary or venture uses patents, software or other technology supplied by the parent U.S. company, then the parent company must also arrange for the same information and technology to be made available for sale or license on a non-exclusive basis to others. The company's U.S. telephone companies are not to develop or enhance software or other technology for the company's foreign businesses, or conduct joint research and development with the company's foreign businesses.

3.5 RBOC Strategies

The RBOCs have followed the investment strategies noted earlier for the PTTs. In many cases, they have invested in ventures providing services they are not currently permitted to provide in the United States. The most common example here is cable television. U.S. RBOCs have invested in cable television properties in geographically diverse locations stretching from Hong Kong through Europe and to Israel. Pacific Telesis, as noted earlier, is an investor in the Japanese international (i.e. long distance) carrier, IDC.

Other investments by the RBOCs have been in more familiar areas like mobile communications, though sometimes using technologies that have not yet been introduced in the U.S., like PCN. Others have invested in overseas computer hardware and software services, leasing and sales akin to some of their domestic ventures, and sought to market their expertise in the provision of modern communications services as consultants. In one case, NYNEX has invested in the local telephone company in Gibraltar.

It almost need not be mentioned that AT&T has focused its efforts so far in finding the right consulting and manufacturing niches and partners, particularly in Europe. It also recently bought a value added services provider in the U.K.

The old PTTs and previously insular American telecom providers have been followed into the international arena by manufacturers like Motorola and Racal, who seem interested these days not only in selling equipment, but also in participating in operations. Even telecom operators who do not face domestic competition have followed suit. Both Telecom Australia and OTC(A) are venturing further and further afield. Singapore Telecom International in 1989 took a equity interest in Mobile Telecommunications Technologies Corporation (Mtel), one of the largest paging operators in the U.S.

4.0 Open and Not So Open Markets

4.1 Mixed Blessings

The new TNCEs have been fortunate in one regard: timing. In general, the same regulatory liberalization that has forced them to seek new opportunities outside of their home markets has been taking place elsewhere. So, they are finding foreign opportunities available.

However, for policymakers, the sudden availability of plentiful foreign expertise in almost every imaginable aspect of basic and advanced communications must be greeted as a mixed blessing. On one hand, in most countries only one organization has developed any sort of telecommunications expertise -- the PTT. A nationally-based manufacturer may have some expertise, but may be reluctant, initially, to come out and compete against what had been its best customer. A few other organizations may initially have a serious interest in developing such expertise, but they do not yet have the personnel trained or hired to immediately introduce services. Therefore, foreign organizations are the logical choices, since they will have the expertise and willingness to invest.

On the other hand, for a country accustomed to having domestic communications securely in the hands of a government-owned entity, or at least a locally-owned company, the thought of opening up the frontiers to foreign investors must cause great concern. Moreover, such concern is heightened because senior policymakers in the government -- not just the telecom authorities -- realize how important advanced communications and information will be to their countries in the future. That is why liberalization is taking place, after all. Policymakers realize that, in welcoming foreign participants into the domestic telecommunications market, they are counting on these companies to help their country stay amongst the technologically advanced in the information age. National policymakers and locally-based consortia members no doubt hope that their TNCE partners will impart knowledge and expertise to the local players.

Moreover, national policymakers must look at this question through two prisms of national interest. One prism is focused on the question who controls or participates in the domestic communications industry. The other is focused on the opportunities available to its former monopoly PTT overseas. These concerns fall within the realm of trade issues, which are often handled by a different set of policymakers than those handling telecom issues. The two concerns must be balanced, because restrictions on foreign investment at home could lead to restrictions on the opportunities available to the former PTT in other countries.

4.2 Varying Reactions

Each country that has achieved significant liberalization has handled the question of what limits to place on foreign involvement somewhat differently. Briefly, based on the information available, it appears that foreign firms have been permitted to participate in virtually all sectors of the British telecommunications market, except the provision of basic long distance telephony. There, a duopoly policy exists which protects Mercury and British Telecom from direct competition until late 1990, at which point this policy is to be reexamined. Moreover, the substantial remaining U.K. Government ownership of BT and the "golden share" which Her Majesty's Government has retained in both BT and C&W would appear to insulate those companies from outright takeover by a foreign investor. Foreign companies have been permitted, however, to participate in other sectors of the telecommunications industry, as Specialized Satellite Service Operators and enhanced services providers. As investors in cable television franchises, foreign firms have also been able to provide local communications services in the U.K., because cable systems are permitted to provide these services in addition to entertainment programming.

On the media side, the U.K. has been grappling with the question of media concentration and cross-ownership. However, it does not seem to have been phased by the fact that the largest newspaper publisher in the U.K. is an Australian-American, Rupert Murdoch. Interestingly, changes in the broadcasting laws now being considered, especially a proposal to permit the commercial television companies' stocks to be traded regularly has been criticized because it would permit foreign nationals to make a "dawn raid" on an ITV company's shares and seize control of a major part of the country's media.

The Federal Republic of Germany, which on July 1, 1989, legally and factually went from being one of the most closed telecommunications markets in the world to being one of the most open on July 1, 1989, is now also permitting a significant amount of foreign involvement. There was, as earlier noted, heavy foreign involvement in all of the 10 consortia bidding for the second cellular license. It appears that foreign entities will also be permitted to participate in the provision of low-speed data communications via satellite and in other forms of enhanced or value added services, and other types of mobile radio services whose introduction is being planned.

Japan has also taken a more liberal approach to foreign involvement in the telecommunications sector under the provisions of the laws put into force on April 1, 1985. Foreign interests may now hold up to one-third of the total equity in a Type 1 carrier and in other types of radio licensees. Foreigners may invest up to 20 percent in broadcasting organizations, as well. There is no foreign investment restrictions on Type 2 value added carriers.

4.3 The American Irony

U.S. trade and telecommunications policymakers have, of course, welcomed these developments -- indeed, they had pressed for them in Germany, especially -- and called for even greater openness in telecom markets around the world. In American eyes, the U.S. market is the most open in the world, as evidenced by the wide-ranging competition here. Foreign-made equipment has flooded the U.S. market since the relationship between AT&T's Western Electric subsidiary and its local telephone companies ruptured; and competition introduced into the customer premises equipment (CPE) market. (While the U.S. has complained and fumed about the sudden change in the balance of trade in telecom products, little has been done to raise barriers, so far.) Foreign companies have become significant participants in the telecom services arena, especially BTI and Cable & Wireless.

However, the American posture that the U.S. is still the example to which others should aspire may no longer be justified, at least on the issue of foreign involvement in the provision of telecommunications services. U.S. trade and policymakers seem generally unaware that in this aspect, some of its closest allies have overtaken it as examples of openness to foreign involvement in telecommunications.

Restrictions on the involvement of foreign entities and individuals in the U.S. telecommunications and broadcasting industries stems from a part of the Communications Act of 1934, the basic document governing U.S. communications. In that part of the law covering the use and regulation of the radio frequency spectrum, there is a section which specifically addresses the issue of foreigners directly or indirectly holding interests in various types of radio licenses. In summary:

- No radio license of any kind may be awarded to or held by a foreign government or its representative.
- No broadcast, common carrier, or aeronautical fixed or en route radio station license can be held by any alien (foreigner) or representative of one; any foreign corporation; any corporation with an officer or director who is an alien, or in which more than 20 percent of the stock is controlled by an alien, a foreign government or a foreign corporation. No corporation can hold a radio license either, if it is directly or indirectly controlled by another corporation (a holding company) which has an alien officer, or if more than one-quarter of its board of directors are aliens, or if 25 percent of its stock is controlled by aliens.

The Federal Communications Commission (FCC) is given authority to refuse to approve the transfer such a license in the latter instance, or to revoke one if it finds out that foreign interests are in control of the radio license holder, if the public interest would be served by such an action.

The implication of this law for a company like Cable & Wireless, which wishes to participate in the U.S. common carrier market in the U.S. has been profound. C&W North American subsidiary has had to construct a national network composed of fiber optic and other non-radio links it has built, bought or leased. If a microwave link has been needed, it has been forced to lease such capacity from another provider, not always the most advantageous or economical way to conduct business in a competitive environment.

The Commission's general approach historically has been to view the wording of this section of the law as a strong mandate to keep foreign involvement in broadcast and common carrier licensees under strict control. Few exceptions have been granted, though it would have the leeway to create a more open climate if it chose a more liberal reading of the law.

In addition to this law, the Commission itself in

1985 sought to keep the spotlight on international common carriers either controlled by foreign interests or in which foreign interests exceeded more than 15 percent. It did this by deciding that it would continue to treat these companies as "dominant" carriers subject to the Commission's full regulatory oversight of tariffs and business dealings. This put the few, small companies in this category in the same league as AT&T and COMSAT, the only other carriers classified as dominant. American carriers of similar size and circumstance, but lacking "foreign" taint, were classified as "non-dominant" and had their regulatory burdens streamlined. How heavy a burden this created for foreign carriers operating the United States is open to question. However, there is no doubt that their burden is heavier than their "All American" competitors.

So far, the rapid emergence of more open markets in certain countries, and the prospect that the number of such open markets will continue to grow in the 1990s, has not led to a reevaluation of these regulations and laws with an eye toward reciprocal liberalization. In fact, the major effort in this area has been in the opposite direction. Congressman Edward J. Markey, the chairman of the House of Representatives' principal subcommittee on telecommunications, introduced a bill into the U.S. Congress last year that would impose the current foreign ownership restrictions on broadcasting, common carrier and aeronautical licensees onto cable television systems and similar satellite and terrestrial systems that distribute multiple channels of programming. The focus is somewhat curious, since there appears to be only one major foreign investor, Maclean-Hunter, a Canadian company, with significant cable interests in the U.S. (Another Canadian company, Rogers, sold its large holdings to a Houston-based public utility in 1988.)

Congressman Markey, who proposed the bill, may have been responding to several concerns expressed commonly in Congress. The first is grave concern about America's seemingly intractable trade imbalance and growing concern about foreign investment in key sectors of U.S. industry. The second is concern about the growing vertical and horizontal concentration of the cable television industry in the United States since the passage of the Cable Communications Policy Act of 1984. The cable industry is seen in some quarters as growing too powerful in relationship to other sectors of the entertainment industry. Markey's concern may also be that, with cable now reaching about 57 percent of American homes, and with the power to control the choice of programming, cable has become an important arbiter of the information received by the American public. Thus, the question of who (and their nationality) controls cable companies becomes of greater importance.

In any case, Markey acknowledged, to a certain extent, the changing international environment in his bill by including a reciprocity provision limiting foreign investors to less than 20 percent ownership of a U.S. cable system, if the laws in its home country places a limit lower than 20 percent on American investment in systems there. There is no provision in the bill, as it was introduced, for higher ownership limits to be permitted, if a foreign country permits higher or unlimited levels of foreign participation in its cable television industry.

The reaction of U.S. policymakers to the creation of foreign media-based TNCEs has been to cheer, in some circumstances, mergers that a few years ago they would have decried. The Time-Warner merger last year falls within this category.

5.0 Need for Domestic and International Consensus

5.1 Timing Right, Inclinations Misdirected

Congressman Markey's introduction of his bill, the Cable Television Foreign Ownership Bill of 1989, is timely at least, because it focuses U.S. policymaker's attention generally on the question of foreign participation in the U.S. communications industry. That industry is far different today than it was when Congress wrote the foreign ownership restrictions into the Communications Act of 1934. In fact, American anxiety about alien control of communications facilities goes back to World War I, during which United States policymakers found -- to their discomfort -- that most of the radio communications facilities in the country were under the control of British Marconi. Those facilities were placed under American control (under RCA) after the war. The emergence of radio as a mass medium reaching most of the American public probably encouraged Congress to place broadcasting in the same league with common carrier radio licenses in writing the 1934 Act.

Today, the American communications industry is altogether different than it was in the 1930s, or even as it was in the 1970s. The common carrier sector is subject to vibrant competition. AT&T has continued to lose market share to its domestic and international telecommunications competitors. Virtually every other sector, from mobile to enhanced services, has many competitors. In the field of mass media, the primary concern about concentration these days is over the so-called cable television multiple system owners (MSOs), who like the local telephone companies, have a virtual monopoly in their franchise areas. The conventional, commercial over-the-air broadcast networks which used to dominate the American entertainment industry have continued to lose audiences to the many other channels of programming available through cable television systems, as well as to the videotape recorder.

5.2 Reevaluation Needed

In light of the well-developed nature of the U.S. communications industry, American policymakers need to reexamine openly what their concerns -- their fears, really -- are about foreign involvement in the industry. This reevaluation needs to be done with one eye on the rapidly changing international telecommunications and media environment. On one hand, it may appear frightening to some, because of the increasing number of TNCEs being spawned. On the other hand, American policymakers need to realize that there are as many or more American companies either already investing overseas or capable of doing so.

Generally, when all else is boiled away, American policymakers primary concerns appear to be:

5.2.1 Control of Information Reaching the Public

This is a concern, whether power to control access to the public through the media becomes concentrated in the hands of a domestic or foreign entity. The concern seems to be greater, however, if the information provider has a foreign origin, even if the role of information gatekeeper is played largely by American employees.
Rather than focusing on the nationality of the information provider, existing cross-ownership laws can be reexamined -- and need to be periodically anyway, because of market and technological changes -- in light of the evolving market strength of the various media (broadcast, cable, print, computer-based) and reshaped where needed to ensure that the public receives information from a variety of sources.

5.2.2 National Security

Another concern has been that in the event of national emergency, especially war, that it be Americans who would be asked to respond to the President's call either to assist in the national effort or shut down operations, if needed. While concern about war seems to be receding in light of recent events, these concerns must be taken seriously. One might ask, however, whether we would expect a foreigner holding a radio or common carrier license that requires him to respond to emergency directives to respond differently than an American in these circumstances, especially if the threat of seizure or other drastic action is implicit or explicit.

5.2.3 Serving the Public Interest

A more amorphous concern is whether a foreign-owned operator can be expected to serve the public interest as well as an American-based owner. The problem comes in defining the public interest as it applies to various types of communications enterprises. Generally, the Federal Communications Commission backed away during the "deregulatory 80s" from attempting to apply too strict a "public interest" standard on broadcasters, to whom it had been applied with the greatest vigor in the past. Rather, the FCC has taken the position that the best assurance that the public interest will be satisfied will be to permit open competition in a free market as much as possible. In this way of thinking, the public interest is largely defined as what the public demands and for which it is willing to pay.

Using this standard, allowing additional foreign competitors into the market would seem to guarantee that the public interest is met, especially if concentration of the domestic industry is a concern. If the foreign operators do not supply desireable services, then they will not survive in the marketplace. Any other public interest requirements that might be specific to the individual telecom service provided could be explicitly stated and applied to all participants in the market, whether foreign or domestically owned.

One is tempted to suggest that a code of "Good Communications Enterprize 'Citizenship'" be developed for all manner of communications market participants. This would run counter to the deregulatory trend in the U.S. during the 1980s, but development of such a standard might be one way to assure the policymakers and public that local interests will be protected if greater foreign participation is to be permitted.

5.3 International Consensus

It would be politically impossible within the U.S., of course, to impose such an open regime without some acknowledgement of the international political and trade situation. Were the United States willing to adopt such an open market approach, it would be necessary as well to seek international consensus on standards of openness or else to impose measures assuring reciprocal treatment. U.S. rhetoric about the desirability of open markets would indicate that it should be willing to take the lead in this effort.

An effort should be made to seek an international formal or informal consensus on the manner in which markets should be opened. The chances of achieving such a consensus improve day-by-day. The regulatory changes taking place in Europe under the banner of EC '92 provide an opportunity to bring all 12 countries of that group into discussions on this matter. The transformation of domestic PTTs in other countries into TNCEs should mean that other countries would join such a discussion as well.

6.0 Conclusion

For the United States to lead such an effort, however, may require some unexpected soul-searching on its part in the form of a review of the restrictions it places on foreign involvement in the domestic communications market.

The time is ripe for a review of American Old Assumptions and past policies in light of the rapid changes which are beginning to take place around the globe. General concern about the implications of greater foreign involvement in the domestic market should be balanced against the realization that the vibrant and diverse U.S. marketplace has produced a large number of TNCEs who can profit from greater openness of foreign markets.

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Session 1.6

Major Issues in World Communications

Panel Discussion

Chair: L.S. Harms, University of Hawaii

NOTES

Session 2.1

Impact of Telecommunications Technology on Intellectual Property Rights

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NOTES

TELECOMMUNICATIONS AND INTELLECTUAL PROPERTY

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Intellectual property protection is a subject that will have a significant impact on the international expansion of the telecommunications business. Current national and international systems for the protection of intellectual property have undergone several significant changes, however, a continued focus on this area of the law is still required.

1. INTRODUCTION

Today, multinational corporations consider improved safeguards and the harmonization of laws and rules relating to the protection of intellectual property to be of significant importance in their ability to compete effectively in the marketplace around the world. A recent published report by the Conference Board, Inc. entitled, Safeguarding Intellectual Property based on surveys of 164 U.S., Canadian and European countries supports this view. Activities in the U.S. and overseas involving intellectual property issues will, therefore, have an important impact on the expanding worldwide business of telecommunications and the intellectual property rights associated with new and innovative telecommunications products and services.

The protection of intellectual property associated with telecommunications is extremely important in light of the recent expansion of the telecommunications marketplace and the competitive interests involved. In less than a decade, the business of telecommunications has become one of the most active and competitive growth industries in the world. There is constant activity in the areas of new product and service introduction to meet the demands of the marketplace. In markets that previously were closed (U.S., Japan, Britain and several European countries), the doors to competition have now been opened. In addition to head-to-head competition, companies are forming joint ventures and partnerships in order to better serve the telecommunications marketplace. As a result, national distinctions are disappearing. U.S., European, Far East and Asian business interests are now competing for business all over the world.

Advancements in technology have spurred on the business of telecommunications. Significant areas of growth appear to be in electronic mail, toll-free calls, ISDN, Videotex, LANs, fiber optic applications and computerized directory services. Advancements in telecommunications hardware and software are also expected to have a significant impact on the world telecommunications and information management market.

With the anticipated improvements in telecommunication technologies, companies will look to the laws of intellectual property to ensure that their valuable property rights are fully protected from infringement and other illegal methods of exploitation. Current laws protecting intellectual property are often times inadequate or ineffective and result in the loss of valuable property rights. In addition, there is a significant need to begin to harmonize differing laws and rules and enforcement matters now in place and establish, as much as possible, worldwide standards for the protection of intellectual property.

2. PROTECTION OF INTELLECTUAL PROPERTY RIGHTS IN THE UNITED STATES

An increase in both domestic and international competition has led to a significant increase in the infringement of intellectual property rights in the U.S. The U.S. International Trade Commission estimates that $61 billion worth of U.S. intellectual property was stolen or infringed in 1986. A report issued in 1989 by the Annenberg Washington Program entitled, Curbing International Piracy of Intellectual Property claims that "commercial piracy of intellectual property costs the U.S. economy tens of billions of dollars and thousands of lost jobs each year." With increasing pressures to provide expanded protection for intellectual property rights, Congress and the U.S. courts have now made several important decisions in this area.

U.S. Congressional Action

Since 1983, Congress has enacted several laws strengthening intellectual property rights. Some of the more significant legislative changes in the past years are summarized below.

In 1988, Congress enacted legislation which provides for U.S. membership in the Berne Copyright Convention. The new law, which became effective March 1, 1989, was designed to bring U.S. law into harmony with the Berne Convention. Berne membership is expected to strengthen U.S. international copyright relationships. A report issued in April, 1989 by the International Intellectual Property Alliance (IIPA), a coalition of U.S. industry groups interested in the international protection of copyrights, estimated that piracy of copyrighted works resulted in lost sales of $1.3 billion annually for U.S. companies. The U.S. alliance to the Berne Convention is expected to assist in combating piracy of these works. In order to harmonize U.S. law with the Berne Convention, several amendments to the U.S. copyright laws were made. Some of the significant changes include:

1. The elimination of the mandatory copyright notice. Under prior law, all copies of a published work were required to have a copyright notice affixed to the work. Although the notice is not mandatory, the Act provides an incentive for its use. When it is used, the defense of "innocent infringement" is unavailable to a party accused of copyright infringement. From a practical point, it is recommended that all copyrighted works continue to use the copyright notice (© or copyright, date and owner name). Also, for works published after March 1, 1989, a party must presume that, without proof to the contrary, a work is protected by copyright, regardless of whether a notice is used.

2. The elimination of registration as a prerequisite to the filing of a copyright infringement suit. For works originated in a Berne Convention country (other than the U.S.) the holder of the copyright can file suit before registering the work with the U.S. copyright office. It is, however, still recommended that important copyrighted works be registered. U.S. law provides for statutory damages and prima facia evidence of copyright validity for works that are registered prior to the filing of a lawsuit.

In 1988, Congress also made major revisions to the 1947 Lanham Trademark Act. The revisions are intended to respond to the various changes in the nature of marketing both in the U.S. and overseas, and to bring U.S. trademark law more into line with foreign trademark laws. One significant change to the Trademark Act is the allowance of trademark applications based upon a bona fide "intent-to-use" the mark in commerce. Prior to November 16, 1989, U.S. applications to register a mark could only be filed after the mark had been used in commerce. Under the "intent to use" system a party is now able to proceed with filing an application to protect a trademark or service mark before actual use is made.

The intent-to-use application procedure supplements, rather than replaces, the actual use requirements of existing law. In fact, while the new law permits an application to be filed based on an intent-to-use the mark, the applicant will still have to make actual use of the mark in commerce before the mark can be registered. The applicant will have to state that there is a "bona fide" intention to use the mark in commerce, on or in connection with each of the products or services specified in the application.

The examination process at the Patent and Trademark Office ("PTO") will also be comparable to existing practice. The Examiner will review the application and if approved, the application will be published for opposition. If the mark is not opposed, the Examiner will issue a "Notice of Allowance" to the applicant, indicating approval of the mark for registration. While the application is pending, the applicant will have the benefit of "constructive use priority." This means that, subject to the mark actually being registered, the applicant will have prior rights in the mark against all others nationwide (except for those who used the mark before the application was filed, filed an earlier application, or had priority based on a foreign application).

Following the issuance of the Notice of Allowance, the applicant will have six months in which to submit a "Statement of Use" and accompanying specimens, evidencing that the applicant has commenced actual use of the mark in commerce. The applicant will automatically be granted an extension of six months if he cannot submit a Statement of Use within the first six-month period. Additional extensions of time (up to two years) will be granted based on a good cause showing. Once the Statement of Use has been submitted, the examiner will reexamine the entire application. If the examiner approves the application, the mark will be registered.

As with any new law, a number of issues still need to be resolved including: What constitutes a "bona fide" intention to use a mark? What constitutes "good cause" justifying an extension of time to file a "Statement of Use?" What type of "use in commerce" is needed to obtain a trademark registration?

There are several things which companies can and should be doing to keep pace with the changes in business practices that are likely to develop as a result of the new law. First, because the new law became effective November 16, 1989, companies should begin thinking about the new products and services that they will bring to market over the next few years, and the marks that they would like to use in connection with them. Second, some long-range planning may be helpful to satisfy the bona fide intent requirement. Companies should plan to mention in their internal annual business plans, or long-term strategic plans, their interest in and intention to introduce certain kinds of products or services bearing certain marks. Finally, strategic planners in the company should begin to think of the PTO as a source of valuable information about competitors' business plans. A review of the PTO's trademark application files is likely to disclose a great deal about the goods and services that will be placed on the market by applicants.

The new law also impacts on the area of false advertising and unfair competition. Under existing law, Section 43(a) clearly prohibits a firm's false statements about its own goods. It has likewise been read to bar false comparative advertising on the theory that a false claim about one's own goods is, if not explicit, then implicit in every false comparative claim. But Section 43(a) has not reached commercial disparagement or defamation of a competitor's product in the absence of a comparative reference to one's own goods or services.

The new law creates a federal cause of action for commercial defamation by providing for a cause of action under Section 43(a) for any "...false or misleading representation of fact, which...(2) in commercial advertising or promotion, misrepresents the nature, characteristics, qualities, or geographic origin of his or her or another person's goods, services, or commercial activities...." (Emphasis added.)

The intent was to create a fairly broad federal cause of action for commercial defamation but not to curtail truthful comparative advertising. Hence, the same amendment that permits a lawsuit over false advertising aimed at a competitor's goods or services also limits the scope of Section 43(a) to false representations of fact contained in commercial advertising or promotion.

The new cause of action for commercial defamation raises many difficult legal questions. These include: Where is the line between false statements of fact and false statements of opinion? Are false representations of fact not actionable if they are contained in materials other than advertising or promotion? What does it mean to disparage another firm's "commercial activities?"

In 1988, Congress enacted a new trade bill, "The 1988 Omnibus Trade and Competitiveness Act," which includes provisions intended to expand the scope of protection for patent owners. Prior to the law change, even though a patent owner could prove that a foreign competitor violated a patent on a manufacturing process, economic damage had to be proven in order for a violation to be found. Under the new law, all the owner has to do is prove that the patent has been infringed. The new law treats unlicensed importers, distributors, retailers, and even consumers of standard products as patent infringers, if an unpatented product was produced by a U.S. patented process. The Act applies to foreign and domestic manufacture and also to end products that are protected by U.S. process patents.

In 1988, Congress enacted the "Intellectual Property Bankruptcy Protection Act" (effective on October 18, 1988), which is intended to protect intellectual property licensees in cases where the intellectual property licensor enters bankruptcy. The law is intended to establish that a licensee's rights to the subject matter of the license cannot be unilaterally discontinued in the event of the licensor's bankruptcy. Intellectual property for the purposes of this Act includes patents, trade secrets and copyrights but not trademarks.

U.S. Trade Actions

The 1988 Omnibus Trade and Competitiveness Act also provides measures for the U.S. to sanction countries which fail to provide protection for intellectual property rights. The new law is an attempt to strengthen the U.S. government's hand in negotiating improved protection for U.S. intellectual property worldwide and in opening up markets which may be closed to U.S. owners of intellectual property.

Under the new law the U.S. Trade Representative (USTR) "shall identify those foreign countries that deny adequate and effective protection of intellectual property rights" and "shall identify those foreign countries...that are determined by the USTR to be priority foreign countries." If a country is identified as a "priority foreign country," it would be listed in the Federal Register and would be the subject of a Section 301 investigation by the USTR. The USTR is required to determine whether a foreign country is engaged in "unjustifiable, unreasonable, or discriminatory" trade practices. If a foreign country's acts come within this Section, the USTR must recommend trade sanctions to the President. Upon that recommendation, the President would be required to meet a specified deadline in taking necessary action, which could include suspension of trade agreement concessions, the imposition of duties and the withdrawal of designation under the General System of Preferences.

In 1989, the USTR reviewed the intellectual property programs of all U.S. trading partners. As a result of this extensive review, the USTR decided to establish a Watch List and a Priority Watch List of 25 countries that required special attention.

The USTR decided that 17 countries should be placed on a Watch List for special attention because they currently maintain intellectual property-related practices or barriers to market access that are of particular concern. Over the next year the United States will step up its efforts with these countries to resolve the identified problems. Countries on the Watch List include: Argentina, Indonesia, Portugal, Canada, Italy, Spain, Chile, Japan, Turkey, Colombia, Malaysia, Venezuela, Egypt, Pakistan, Yugoslavia, Greece and Philippines.

In addition to the 17 countries on the Watch List, the USTR determined that eight trading partners maintain acts, policies, or practices that satisfy some or all of the statutory criteria for priority country identification. However, because they have made progress in recent bilateral or multilateral negotiations, they will not be identified as priority countries under the statute at this time. The Priority Watch List countries include: Brazil, Korea, India, Saudi Arabia, Mexico, Taiwan, People's Republic of China and Thailand. The USTR has developed accelerated action plans established for each country. The plans in general include commitments toward improved patent, copyright and trademark protection (including new laws and increased enforcement actions) and constructive participation in multilateral intellectual property negotiations.

In its November 1, 1989 report, the USTR downgraded South Korea, Taiwan and Saudi Arabia from its "Priority Watch List" to "Watch List" status. The report indicates that there has been increased activities in general by foreign countries because of the possible sanctions and the growing realization around the world that denial of adequate and effective protection of intellectual property rights is harmful to the national economic interests of all trading nations. The USTR also announced that it was placing Turkey and Malaysia on notice that they must also begin efforts to make significant progress in this area.

Although the efforts of the USTR appear to be moving in a favorable direction, there is still a significant amount of work that needs to be done. Several have voiced concern that more significant improvements have not been forthcoming. The International Intellectual Property Alliance (IIPA) has stated that if there are no significant changes in the laws of the five countries remaining on the Watch List, the IIPA would seek sanctions by April, 1990 (when the next USTR report is due).

Pending Legislation Before Congress

Several bills are now pending in Congress which also seek to strengthen intellectual property rights. Some of the more significant ones include:

Trademark Protection Act of 1989 - S.626 (Sen. Hatch) - This bill is intended to completely prohibit the importation of gray market goods by amending the Lanham Trademark Act. This bill is pending in the Senate Judiciary Committee.

Protection of Industrial Designs of Useful Articles - H.R. 3499 (Rep. Moorhead) and H.R. 3017 (Rep. Gephardt) - These bills would provide copyright-type protection for industrial designs for a term of ten (10) years. This bill is pending in the House Judiciary Committee.

Intellectual Property Protection Act of 1989 - S.1529 (Senator Rockefeller) - This bill which would amend Section 337 of the Tariff Act to strengthen protection for U.S. patent holders against imports of infringing goods. The bill endeavors to provide a remedy for American businesses unable to secure effective patent protection in other countries. The proposed amendment would require the Commissioner of Patents and Trademarks to identify and publish a list of those foreign countries maintaining patent systems that deny protection to U.S. businesses. A manufacturer from any of the listed countries who is subsequently charged with a violation of the Act would not be entitled to any exemptions normally provided for in the statute. This bill is pending in the Senate Judiciary Committee.

Gray Market Goods Act - H.R.3484 (Rep. Cardin) - This bill would amend the Lanham Act to protect trademark owners against the unwanted import of "gray market" goods. The prohibition would apply equally where the foreign manufacturer or trademark owner is related to the U.S. trademark owner, where the mark is registered abroad, or where the owner of the U.S. mark has authorized its use abroad. HR 3484 would also create a private right of action against an importer or seller of gray market goods, allowing the trademark owner to enjoin their importation or sale and to obtain damages and lost profits. This bill is pending in the House Judiciary Committee.

U.S. Court Decisions

Recent court decisions have expanded and strengthened the rights of owners of copyrights, patents, trademarks and trade secrets which has resulted in a tremendous increase in parties seeking court action to protect their rights. In 1988, some 6,059 intellectual property cases were filed in the U.S., 60% more than in 1980. In the area of copyright law, recent decisions have upheld copyright protection for computer programs and related works and established new rules pertaining to the "work made for hire" doctrine under copyright law. The courts have also provided several decisions on the protection of trade secrets from illegal misappropriation and provided protection for a product's trade dress and product configuration and associated trademarks, logos and slogans. Patents have also received expanded protection by the courts. Some of the more significant U.S. court decisions impacting an intellectual property rights are identified below.

Copyrights

The "work made for hire" doctrine (17 USC Section 101) is very important to companies that contract with third parties to develop computer programs, marketing reports, studies, and other works. If a work qualifies as a work made for hire, the legal author will be the hiring party. Otherwise, the actual author will be the legal author and the hiring party must expressly contract for the transfer of the copyright. Termination rights (typically 30-40 years after the transfer) cannot be relinquished by the legal author when transferring the copyright to a third party. The legal author retains no termination right in a transaction deemed to be a work made for hire.

To establish a work made for hire, there must be either (1) "a work prepared by an employee within the scope of his or her employment" or (2) "a work specially ordered or commissioned for use as a contribution to a collective work, as a part of a motion picture or other audio-visual work, as a translation, as a supplementary work, as a compilation, as an instructional test, as a test, as answer material for a test, or as an atlas, if the parties expressly agree in a written instrument signed by them that the work shall be considered a work made for hire." 17 USC 101 (1) and (2). Since many of the works that a company may commission from third parties (independent contractors) may not fall within the enumerated categories above, one must look to the definition of employee to see if the work would be considered a work made for hire.

In June 1989, the U.S. Supreme Court in Community for Creative Non-Violence et al. v. Reid, 109 S. Ct. 2166 (1989) clarified the definition of "employee" for purposes of a work made for hire. In recent years, the Federal Circuit Courts have taken various and inconsistent approaches to this question. The Reid case establishes that the test for employee status will be determined by applying general common law of agency principles to ascertain whether the work was prepared by an employee or an independent contractor. Some of the questions to be answered in order to determine the consultant's status would be: what is the level of supervision by the hiring party; who determines when and how long the consultant will work; who has the discretion in hiring and paying assistants; whether the hiring party has the right to assign additional projects to the consultant; whether the consultant is paid in a manner in which independent contractors are often compensated; whether payroll or social security taxes were paid by the hiring party; or whether contributions to unemployment insurance or workmen's compensation funds were made by the hiring party.

In summary, in those cases where a work made for hire relationship is not established it is imperative that an express transfer of all rights to the hiring company be included in a written agreement between the parties.

Computer software is now widely recognized as being protected by U.S. copyright law. Although there were some doubts as to whether the old Copyright Act of 1909 protected software, the Copyright Act of 1976 and the Software Copyright Act of 1980 expressly provide that software is copyrightable. The courts now have resolved several issues in the area of copyright protection for software but several remain unresolved. It is clear that software, whether it is in object code, source code or microcode is protectable. See: Apple Computer, Inc. v. Franklin Computer Corp., 714 F.2d 1240 (3rd Cir. 1983); Whelan Assoc., Inc. v. Jaslow Dental Laboratory, Inc., 797 F.2d 1222 (3rd Cir. 1986), cert. denied, 479 U.S. 103 (1987); Broderbund Software v. Unison World, Inc., 648 F.Supp. 1127

(N.D. Cal. 1986) and NEC v. Intel Corp., _ F.Supp.__, 10 USPQ 2d 1177 (N.D. Cal. 1989).

The scope of protection beyond the literal code has been endorsed in a case entitled Whelan Assocs., Inc. v. Jaslow Dental Laboratory, Inc., 797 F.2d 1222 (3rd Cir. 1986). In that case the court held that the structure, sequence, and organization of a computer program ("look and feel") are protected by the copyright laws. The defendant in that case infringed the copyright by writing a program in a different language but copied the structure, sequence and organization of the plaintiff's program. The Whelan decision has been followed in many court decisions in the U.S., however, it is still unclear how far copyright protection extends beyond the code itself. In a recent case, Johnson Controls Inc. v. Phoenix Control Systems, Inc., 886 F.2d 1173, 12 USPQ 2d 1566 (9th Cir. 1989), the Ninth Circuit found that a defendant could infringe the plaintiff's copyright in a computer program without copying the literal elements, such as the source code and object code. The adaptability of the program to the individual applications and needs of purchasers shows that there is discretion and opportunity for creativity in the program's structure making it a protectable expression. The court found that a reasonable person could find substantial similarity in the total concept and feel of the two programs involved in the case. See: Manufacturers Technology, Inc. v. CAM's Inc., __ F.Supp.___, 10 USPQ 2d 1321 (D. Conn 1989)

There are also recent decisions that place limits on the expansion of copyright protection to the "look and feel" of a computer program with the courts focusing the copyright inquiry under traditional copyright analysis in an attempt to narrow the rules set forth in Whelan and similar cases. See: Telemarketing Resources d/b/a Brown Bag Software v. Symantec Corp., _ F.Supp.__, 1989 U.S. Dist. Lexis 13012 (N.D. CA. 1989).

The licensing of computer software is an extremely lucrative market, however, both the licensor and the licensee should endeavor to clearly set forth in writing the complete terms of their relationship. Key issues would include rights of ownership of the program, how can the program be used and copied, access to source code and related documentation and the right to modify the program and the ownership rights in the modifications. Failure to clearly set forth these terms can lead to unnecessary litigation. See: S.O.S. Inc. v. PayDay Inc., 886 F.2d 1081, 12 USPQ 2d 1241 (9th Cir. 1989).

Copyright protection for computer programs has evolved over a number of years. The difficulty has been in deciding on how much protection should be afforded to a computer program including the code and related components. Generally speaking, the copyright law does not prohibit the copying of an idea per se, it only provides certain restrictions on that activity. Copyright law does not extend to protection of an idea, only to the expression of an idea. The application of copyright law to computer programs is very difficult because programs combine characteristics which are both creative (protectable) and functional (not protectable). The Apple case cited herein proposed a test that focused on "whether the idea is capable of various modes of expression." It stated that "...If other programs can be written or created which perform the same function as an Apple's operating system program, then that program is an expression of an idea and hence copyrightable." However, it is still very difficult to determine when something is an idea and when is it an expression of an idea.

Trademarks

The courts are increasingly protecting the legitimate trademark rights in names, logos, slogans and designs for infringement. See: Dial-A-Mattress Franchise Corp. v. Page, 880 F.2d 675 (2nd Cir. 1989); C.W. Communications, Inc. v. International Research Service, Inc., 862 F.2d 307 (3rd Cir. 1988); Centaur Communications Ltd. v. A/S/M Communicators, Inc., 830 F.2d 1217 (2nd Cir. 1987); Lois Sportswear, U.S.A. Inc. v. Levi Strauss & Co., 799 F.2d 867 (2nd Cir. 1986). Although courts are very cognizant of trademark rights of parties, they have restricted attempts to expand trademark rights beyond that which Congress and the states have established. See: Mead Data Central, Inc. v. Toyota Motor Sales USA Inc., 875 F.2d 1026 (2nd Cir. 1989) (Mead was unable to prevent Toyota from introducing a LEXUS automobile based on a theory of trademark dilution of their LEXIS name that is used for a legal research service). The area of gray market goods has received significant attention over the past few years including a Supreme Court decision, K. Mart v. Cartier, Inc., 108 S. Ct. 1811 (1988) which approved in part U.S. Customs Service regulations that permitted the import of gray market goods.

The direct infringement of a product's unique features or design is subject to legal scrutiny by courts under the "trade dress" law doctrine. Recent court decisions expanding protection for a product's trade dress appear to be a result of recognition by both businesses and the courts that a product's unique appearance and features can be a valuable asset. The ability to protect product configurations from imitation and copying under trade dress principles is a valuable tool of businesses. The rule provides that product features which are functional are not protectable. "...a product feature is functional if it is essential to the use or purpose of the article or if it affects the costs or quality of the article" Inwood Labs, Inc. v. Ives Labs, 456 U.S. 844, 850-51 N.10 (1982). If a feature is closely related to the purpose, use or manufacture of the product, it is considered functional and can be freely copied.

Although a number of court decisions vary on how one determines when a product configuration is functional, there is a general trend by the courts to focus the functionality inquiry on whether protection for a product configuration will hinder competition or impinge on the rights of others to compete effectively in the sale of goods. See: Sunbeam Corp. v. Equity Industries, Corp., 811 F.2d 1505 (4th Cir. 1987); Sicilia Di R. Biebow & Co. v. Cox, 732 F.2d 417 (5th Cir. 1984); and Jolly Good Industries Inc. v. Elegra, 690 F.Supp. 227 (S.D. N.Y. 1988).

Trade Secrets

Information that provides a company with a competitive edge in business should be properly protected. The courts have over the past decade provided significant legal protections to trade secret information. The increase in key employees leaving jobs for competitors, reverse engineering and other forms of corporate espionage have led to a substantial increase in trade secret litigation in the U.S.

Although courts are now providing protection for trade secrets, they tend to look closely at what the trade secret owner did to protect the information from public disclosure. A company's failure to take reasonable precautions to protect the trade secret may result in no legal protection being afforded. See: Defiance Button Machine Co. v. C&C Metal Products Corp., 759 F.2d 1053 (2nd Cir. 1985). A company that provides several security measures including restricted plant tours, secure facilities, limited access or information to need to know employees, restrictive notices on documents and document shredding may convince a court that its trade secret is worthy of protection. See: Valco Cincinnati, Inc. v. N&D Machinery Services, Inc., 492 N.E. 2d 814 (Sup. Ct. Ohio 1986). The key focus is on what are reasonable precautions that could or should be used. This could include a combination of physical security and confidentiality procedures designed to provide employees and third parties with notice of a claim of confidentiality.

With regard to a specific relationship between an employer and employee, the courts continue to follow the general rule that the employee has a duty not to disclose a trade secret of the employer based on a theory of implied contract or implied duty of confidentiality. See: McKay v. Communispond, Inc., 581 F.Supp. 801 (S.D.N.Y. 1983). It is recommended that a written agreement be executed at the beginning of the employment relationship and the employee be continually reminded of his/her duty to keep an employer's trade secrets in confidence.

Patents

The ability of U.S. patent owners to enforce patent rights has increased over the past few years. One significant factor is the creation of the U.S. Court of Appeals for the Federal Circuit in 1982. The court was created as a result of a need to provide a more uniform application of the patent laws and provides a single forum for patent appeals. Recent reports indicate that the new court has been upholding the rights of the patent owners in about 80% of the cases hear as compared to 30% in cases heard before the new court was created.

Because of this recent support for patent rights, businesses are now asserting these rights in court and through increased licensing activities. Several large damage claims that have received widespread publicity include Polaroid v. Kodak, 789 F.2d 1556 (Fed. Cir. 1986), cert. denied, 479 U.S. 850 (1986). ($5.7 billion for infringement of instant camera patent) and Hughes Aircraft v. U.S., 862 F.2d 320 (Fed. Cir. 1988) ($1.2 billion for infringement of a satellite patent). It was recently reported that Corning, Inc. will receive a $25 million settlement from Sumitomo Electric Industries Ltd. for infringement of two Corning patents on optical fibers. Another important area in the patent field is patent protection for computer program related inventions. As a result of Supreme Court decisions in 1981, (Diamond v. Diehr, 450 U.S. 175 and Diamond v. Bradley, 450 U.S. 381) patents claiming various types of program-related inventions are now considered valid. In recent years the PTO has been issuing a significant number of patents involving computer programs. A number of these patents fall in categories such as process control, computer-implemented business methods and human/computer interface. Because there has been very little litigation in this area (Paine, Weber v. Merrill Lynch, 564 F.Supp. 1358 (D. Del. 1983), which upheld the patent and a pending case College Savings Bank v. Centrust Savings Bank, filed in the U. S. District Court in Miami in April 1989), it is still open as to how the courts will enforce these new patents.

However, it is noted that with this potential expansion of legal protection for computer program related inventions, businesses must begin to prepare accordingly.

3. PROTECTION OF INTELLECTUAL PROPERTY RIGHTS OVERSEAS

Foreign countries are also taking steps to strengthen or enforce laws which protect the rights of intellectual property owners and are advocating changes in the way intellectual property is treated worldwide. These efforts include the adoption of stronger laws protecting intellectual property rights and the negotiation of bilateral agreements with the U.S. There appear to be several reasons why foreign countries are now providing an increased focus on intellectual property rights. One major reason is the United States efforts to make worldwide intellectual property laws compatible with the interests of the U.S. Another reason is the increased focus on harmonization of these laws which many foreign countries now see as necessary in order to establish uniform rules to promote increased trade among countries. Some of the significant foreign legislative changes include:

INDONESIA - Although Indonesia has been an area of significant counterfeiting and piracy, they recently signed a bilateral treaty with the U.S. (effective 8/1/89) to protect each other's copyrights.

BRAZIL - Legislation approved in 1987 permits foreign software manufacturers to market their products in Brazil after the Special Secretariat of Information (SSI) approves the software for registration.

CHINA - The Chinese government has agreed to submit a draft copyright bill (which reportedly includes computer programs within the scope of its protection) to the State Council and the National People's Congress Standing Committee (NPC) by the end of 1989. The bill could be enacted into law in March of 1990. China is also in the process of amending its patent laws to extend the term of protection and expand the scope of protection.

ISRAEL - The Israeli parliament has amended their copyright law to provide protection for computer software.

URUGUAY - The Uruguayan Copyright Council has now agreed that computer programs are protectable under copyright law. The government issued Decree 281/89 which stated that computer programs may be registered before the copyright office, and that they constitute copyrightable works under Article 5 of the 1937 Copyright Act.

SWEDEN - The Copyright Act of Sweden was amended to explicitly state that computer programs are protected under copyright law. The new law is effective July 1, 1989.

TAIWAN - An agreement in January, 1989 was reached to establish bilateral copyright relations with Taiwan and the U.S.

4. DEVELOPMENT OF WORLDWIDE STANDARDS FOR THE PROTECTION OF INTELLECTUAL PROPERTY

The current worldwide international system of protection consists of the Berne and Universal Copyright Conventions which cover copyrighted works; and the Paris Convention which covers industrial property including patents and trademarks. The World Intellectual Property Organization (WIPO), has limited enforcement powers of these treaties. Although the current system provides protection in several areas there are significant problems with this system. These treaties do not provide effective powers to enforce rights or provide a means to settle disputes. Membership in the different treaties vary resulting in lack of uniformity in the application of rules and protection measures. As a result, the level of intellectual property enforcement varies from country to country.

Recognizing a need to provide uniform protection in this area, there is now an emerging consensus in advanced industrial countries concerning the need to develop worldwide standards of intellectual property protection. Such safeguards are increasingly important because of high product development costs; the ease with which inventions or original works can be copied or imitated; the accelerated pace of invention; new forms of intellectual property (i.e., computers, computer software); and the ability of several countries to severely impact the economic viability of important industries. Some of the major activities focusing on the worldwide protection of intellectual property include:

GENERAL AGREEMENT ON TARIFFS AND TRADE (GATT): An international organization established to enforce certain tariff and trade rules, originally signed in 1947 by 23 countries, including the United States. The current membership of 96 countries seeks a relaxation of trade barriers through implementation of three basic principles: (1) equal, non-discriminatory treatment for all trading nations; (2) reduction of tariffs by negotiations; and (3) elimination of import quotas.

In 1988 the European, Japanese and U.S. business communities represented by UNICE (Union of Industrial and Employer's Confederation of Europe), Keidanren (Japan) and the Intellectual Property Committee (U.S.) issued a joint statement on intellectual property protection. The statement called for the subject of intellectual property rights to be included in GATT negotiations. The objectives of the group include the establishment of a code that provides (1) non-discriminatory enforcement of intellectual property rights; (2) dispute settlement procedures to ensure that the domestic laws of GATT signatories include basic intellectual property protections and enforcement procedures; and (3) preferential trade treatment for signatories to encourage adherence to GATT intellectual property protection standards. The United States has proposed "minimum standards" for the areas of patents, copyrights, trademarks, trade secrets and semiconductor chip design. However, several developing countries oppose even minimum standards because their current practices fall far below even these minimum standards.

In July 1989, GATT negotiations were held by the Trade Related Aspects of Intellectual Property Rights Committee (TRIPS) on the subject of intellectual property protections. Several new submissions on the subject were considered in these negotiations including proposals from Australia, the European Community (EC), India, the Nordic countries and Switzerland. The proposals from Australia, the Nordics and Switzerland were similar to the U.S. and Japan proposals. The Indian paper proposed that only restrictive or anti-competitive practices of owners of intellectual property rights that distorted or impeded international trade should be the subject of negotiation. They also pointed out that in the areas of patents and trademarks, special or more favorable treatment should be granted to developing countries. The European Community (EC) proposal included recommendations that enforcement procedures should not be unnecessarily complicated, treating foreign nationals in the same way as citizens of the home country; criteria applied in deciding whether an intellectual property right had been breached should not discriminate between domestic and imported goods and services; and intellectual property rights should be granted or registered in a reasonable time, so as not to curtail the period of protection.

In November, 1989, further negotiation sessions were held by the TRIPS Committee. At that time new proposals were submitted by Canada, New Zealand, South Korea and Peru. All four of the proposals found that the Paris and Berne Conventions, administered by the World Intellectual Property Organization (WIPO) are relatively ineffective. The TRIPS Committee is expected to meet on December 11, 1989 to review the issues further while the members of GATT will address the subject at their annual meeting in December, 1989.

As expected, differing views have been given on these proposals from the industrialized nations and developing countries. Industrialized countries have tended to see the need for additional protections and questioned the protections now provided by international convention. Developing countries expressed concern that certain proposals would require significant changes in their own legal systems. These conflicting views remain a major obstacle to consistent international protection of intellectual property rights. It is now reported that the Trade Negotiations Committee of GATT will conclude the Uruguay Round Table Talks next year in Brussels between November 26 and December 8, 1990.

EUROPEAN COMMUNITY (EC): This organization includes most Western European countries. The EC Member states have ceded certain authority to the EC to regulate (among other matters) commerce in intellectual and industrial property. Under the Single European Act, Members of the EC must take steps by the end of 1992 to remove physical, technical and fiscal barriers to the free flow of goods and services within the community. The EC Council of European Communities has issued several directives which seek to harmonize the intellectual property laws of the Member states.

In the area of trademarks, EC directives have been prepared which provide for harmonization of conditions for obtaining and continuing to hold a registered trademark in the member states. Although it does not require harmonized procedures for negotiation, revocation and invalidity in the member states, it clarifies priority rights, and should help reduce trademark law conflicts among member states. The directive also proposes a community trademark which would be valid throughout the EC, receive uniform protection under the legal systems of member states, and exist alongside national trademarks. This change would effectively eliminate the need to apply for trademarks in the separate member states.

Copyright protection for computer programs has also been the object of an EC directive. Key sections provide that computer programs are protected by copyright; copyright interests created by employees within the course of employment vest with the employer; a commissioning party acquires the copyright ownership in preference to an independent third party who is commissioned to write a computer program; copyright owners have the right to control copying, adaptation and distribution of the program, including rental; and a computer program is protected by copyright for 50 years.

The Luxembourg Convention (Community Patent Convention) is expected to establish a community patent system. Questions of invalidity will be handled by a central authority in the European Patent Office. Infringement actions would remain in the national courts but such actions would have a community-wide effect. As a result of a community patent a patentee will benefit from reduced costs of administration of a patent portfolio. Denmark and Ireland have not yet ratified the Luxembourg Convention.

5. WHAT YOUR COMPANY CAN DO TO PROTECT INTELLECTUAL PROPERTY IN THE U.S. AND OVERSEAS

Identified below are several actions that a company can take to prevent the misappropriation and infringement of valuable intellectual property rights. It should be noted that because intellectual property laws of the U.S. and foreign countries differ in many ways, legal specialists should be used to determine the best ways to protect valuable property rights in a particular country. Active involvement by a company is required to ensure protection of its valuable intellectual property rights.

Trade Secrets

As companies become increasingly dependent on information to effectively compete in worldwide marketplaces, it is extremely important that a complete program for protecting trade secret information be established. Included in the program should be the establishment of internal and external security practices; company policies identifying what information is trade secret and how employees should treat this information; employee invention assignment and non-disclosure agreements; company policies relating to the disclosure of trade secret information to third parties and appropriate written agreements. With the uncertainty as to protection for trade secrets overseas, it is emphasized that additional precautions should be taken: i.e., investigate and be selective about whom you trust with your information; in any relationship ensure that the other party is motivated to preserve your information; minimize the amount of information to be provided and release only to "need to know" people pursuant to a written non-disclosure agreement; and don't disclose your information in countries where your rights and remedies are questionable.

Trademarks

The protection of company names, trademarks, service marks, logos and trade dress is vital to a company's ability to compete. A company's trademark procedures should include: legal clearance prior to adoption and use; corporate policies outlining proper procedures for use of marks; the registration of all marks used by the company and corporate policies to ensure the policing of misuse and infringement of marks.

Copyrights

The protection of copyrighted works of a company also requires attention. Corporate policies should be developed to assist in determining when copyright protection is available and the procedures necessary to perfect copyright protection. Corporate policies should be established regarding internal and external use of copyrighted works of others and the acquisition of copyrighted works by written agreement from third parties.

Patents

The protection of patentable inventions is also vital to the competitive standing of a company. Procedures should be established which provide for legal review of all proposed inventions and ideas to secure timely patent protection; procedures and written agreements should be used to obtain the assignment of employee inventions, ideas and other works to the company.

U.S. Customs

The establishment of an anti-counterfeiting program within a company may be necessary to halt these activities. Enforcement steps could include the registration of trademarks and copyrights with U.S. Customs (See 19 C.F.R. Sections 133.1-133.7 (1985); an educational program for employees, distributors and retailers, and the establishment of an in-house enforcement team.

Changing Technologies and Intellectual Property: The Economic Perspective

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ABSTRACT

This paper deals with the intellectual property issues that confront innovators and users of computer systems linked to each other across national borders. It examines the theoretical and conceptual underpinnings of copyright for computer software in economic terms and with empirical illustrations. There is a brief overview of the legal aspects to better explain GATT's involvement caused by the impact of intellectual property protection on trade.

DYNAMIC INNOVATIONS in information technologies have made them a strategic resource in the intense competition to control global markets. As a consequence of technological changes there is a growing concern internationally over the protection of intellectual property as a leading economic and trade issue. The microcomputer revolution accelerated the rate of change, bringing about dramatic effects in the structure and organization of the information industry. Linked with the issue of services trade, the comparative advantage generated by new technologies will determine which country will reap the highest gains from trade in a world market tied together by computer and telecommunications networks. The global efficiency of world trade has increased as a result of technologies like optical fiber, undersea cables, satellites and mobile communications technologies, and integrated systems digital networks which combine voice, video, and data capability all in one channel. The costs of using such technologies are declining on account of deregulation of common carriers even as the new technologies are destroying their natural monopolies.

The rate of change has created a high level of obsolescence in information technology since the world is experiencing an unparalleled explosion of innovative applications of such technologies. These have contributed to an acceleration in the choice available to consumers but have complicated the ability of innovators to control their intellectual property and reap their rewards (Benko 1987). Over the past few years there has been a large-scale decline in the price of computing power and data storage costs so that computing facilities that a decade ago were available only in laboratories and for commercial users are now widely available to the public. This new international trend is oblivious of national frontiers.

Concern for Intellectual Property Protection (IPP) stems from the larger issue of how to provide incentives for new and creative technology, which is essential for competition, and simultaneously keep the free flow of information intact. As the U.S. deficits in the balance of payments grow from year to year, policymakers become apprehensive of technology ownership and the losses sustained by U.S. industry as a result of free riders and piracy of intellectual property.

Even if intellectual property is protected, there is no guarantee that market efficiency will be met with the diversity and rate of current technological innovations. The inherent characteristics of the output, such as software and videotext and video cassettes, make it impossible to ensure market efficiency along with protection of copyright. The existing systems of IPP virtually rule out the possibility of affecting an equilibrium between the interests of producers and consumers of intellectual property in globally integrated markets (see Besen 1987).

In this context, the theoretical underpinnings of intellectual property rights in economic terms vary among the rights of the producers and those of the consumers. They also vary among different forms of protection such as patents, copyrights, and trade secrets. The economic rationale of trade secrets is based on product differentiation, whereas patents and copyright are designed to stimulate invention, which in turn generates competitiveness and promotes economic growth.

The main criterion by which technological innovations proliferate is that knowledge-intensive output should be a "free good" or one whose value does not decrease with use. In other words, one person's consumption of a knowledge-intensive product does not interfere with another person's consumption of the same product. Social welfare would be maximized if no charge were made for such products. A zero price would achieve the optimal allocation of resources. But while the marginal cost of reproduction of an innovation may be zero, the cost of initial creation may be very high. These costs have to be recovered. Once the knowledge of the innovation is in the public domain, there is little chance of appropriating returns from it. Therefore, social welfare can be maximized in a static sense, but dynamic efficiency for future creativity will be wiped out. In such an analysis, the cost of the original is important. Copying software or photocopying books permits knowledge acquisition at less than the cost of purchasing the original. This reduces the number of originals sold and inflicts economic harm on the producer. In the long run, producers may respond by raising the price of the originals. In this case, copying makes both producers and consumers worse off. The implication is that the interests of the producers and consumers diverge significantly. In reality, copying increases as the price of the original is raised. It will then be in the interest of the producer to keep the price lower and use marketing techniques to sell more originals. This is what U.S. publishers of textbooks have done over the years by producing or licensing low-cost copies of American textbooks in Third World countries to reduce the economic effects of indiscriminate copying. Even this preventive measure did not stem the growth of illegal copies.

IPP is designed to ensure quasi-rents or monopoly profits to the producers and put a damper on copying. The copyright or patent confers economic incentives on the owner of intellectual property by limiting competition. The form of monopoly varies between patents and copyright. Patent protects the invention whereas copyright protects the *expression* of an idea and not the idea itself. Each of these is intended to balance the social costs and benefits.

Technological advances in computerization have enabled the producers of software to put encryption devices or technical methods to safeguard their originals. Such protection raises the price because costs are higher, or alternatively if copying can be technically prevented, lower prices may be a viable option. Even with such safeguards, computer crime is prevalent and "hackers" are able to attack networks with in-built security. For example, in 1987, a group of West German students broke into the Space Physics Analysis Network of the United States. This network developed by NASA connects research centers throughout the world. Despite the level of security, this group of hackers penetrated the system and implanted "Trojan horses," that is, programs that allow rights to unauthorized users. The hackers themselves admitted the infringement after they realized that detection procedures were underway and their position had become vulnerable. The security system of the Digital Equipment Corporation computers has since been made more stringent.

It is obvious that technological change is speeding faster than the legal structure that governs it. The product's life cycle is becoming shorter, undermining the system of IPP. Voice publishing is a new industry that will create problems of copyrights. It provides user-friendly access to data bases by telephone. There is no need to understand computers. As a mechanism for imparting information, voice publishing is as important as the printing press. Telsis is one of the leading U.K. manufacturers of voice-publishing technology. Intelligent digital systems have contributed to the expansion of this technology. The computer recognizes certain key words from the caller and gives an appropriate response. The calls can be made at premium rates and are likely to bring in $100 million a year. The revenue is divided between the service vendor and the telephone company. *The Financial Times* supplies business information through voice publishing. Marconi, a subsidiary of GEC, manufactures the digital equipment and plans to exploit the potential of speech-independent systems for accessing data bases. With such a technology that requires no identification of the caller or user, the data base provider assumes the responsibility for providing copyrighted materials. While at present such voice-publishing data bases can be accessed only within the country, there is potential for international usage also. Restrictions on copyrighted materials stored in such data bases will negate the value of using the technology. Closed user groups like multinational corporations will use such a system for transborder data flows. Detection and monitoring of infringement of copyright will be too costly in economic and social terms and will far outweigh the benefits. Freedom-of-information rights will be negated if these costs are incurred, and enforcing copyright laws on voice-publishing technology may prove counterproductive.

The only alternative to monitoring usage is to make data base information available at a fixed price. Such a price can cover the costs of communications and data storage (which are declining) and provide royalties to copyright holders of information. It is possible that users may value the information differently, in which case price discrimination can be adopted based on demand elasticities. Even so, it is possible for users to download an entire data base and then resell portions of it. The copyright problem would then become more complex. However, the cost of continued upgrading of the data base may prevent such practices.

If the data base information is used as a building block for the creation of new information, then restrictions on its use would generate inefficiency in the process of new knowledge output. The problem in such a case is one of balancing the need to liberalize building upon previous knowledge as against the need to encourage initial creativity. If, however, the data base is for a closed user group such as a multinational firm, then all employees will have free use of the data base in order to create new information. Another form of internalized use of copyrighted work would be the outright purchase of the right to use copyrighted materials. If there are no close substitutes available, the price will be high. The ex ante solution to such a problem can be a price that not only rewards the creator of information in the past, but rewards future creativity also. In other words, a price that serves as an incentive to future knowledge creation would be fair and affordable for further innovators.

Unauthorized duplication of software is another hazard created by rapidly advancing technology. The computer itself has the in-built capability to copy software without detection. Unauthorized software duplication has an impact on the publishers' profits. There has been a growing infringement of software publishers' copyrights as the computer industry expands and diversifies. Despite the copy-protection devices used by software publishers, 50 percent of all microcomputer software in use in 1986 has been pirated. In 1986 major software publishers began removing copy protection from their products. Yet computer crimes are on the increase, and unauthorized copying is illegal, because software is considered a creative work worthy of protection under the copyright law.

The economic impact of software duplication on market forces and on suppliers, needs to be considered before a decision can be made on whether such unauthorized copies increase the profits of the publishers or harm their interests. Johnson (1985) assumes that unauthorized copies are equal in value to originals, that the marginal cost of unauthorized copying varies between copiers, and that the marginal cost of an unauthorized copy is higher than the marginal cost of producing an original. These assumptions impose limitations on the application of the Johnson model to computer software. Generally, the quality of the copy is below that of the original. Software used to create unauthorized copies is widely available, and the cost of an unauthorized copy is only the cost of the diskette, which is well below the producer's marginal cost, which includes documentation and product support (Benham and Wagner 1987).

If a group of software users decides to purchase one original each and then exchange these for copying purposes, the exclusion principle bars nonmembers of the club from the privileges of exchanging and copying software. In the Benham-Wagner model, it is assumed that the quality of the copies is not as good as that of the original and that this quality declines as membership increases. It also assumes that the cost of unauthorized copies to the club members is less than the purchase price of the original. Despite the disadvantages of poor quality of software copies, which gets worse with the growth of membership, such clubs generate increased sales, which may not have taken place if copying were successfully prevented. This in turn means that it is possible for the publisher of software to get increased revenue from clubs by charging different prices to different users. Club users could be charged higher prices, but only if nonmembers can be excluded. Producers cannot use price discrimination if nonmembers cannot be excluded from copying. The problem of free riders cannot be avoided. If there are barriers to entry to the club, then the market will be characterized by monopolistic competition. In this case, software publishers will not lose revenue if they can raise prices to cover the cost of copying.

Another innovative technology that challenges the privacy of proprietary information is the storage and exchange of financial data through electronic funds transfer. SWIFT represents an exclusive club of member banks which exchange financial funds through electronic networks. The problem of privacy arises in the case of new technology that permits access to private data. The integrity of the banking system determines the confidentiality of government, business, and individual financial transactions. Therefore, the software used by banks for inputting such information on individual accounts should be protected under strict copyright laws. If such software is pirated or broken into, financial losses will be heavy on a global scale. To avoid such a contingency, membership fees of SWIFT are much higher than the marginal costs of interbank data transfers, and the software program is not open to use by an individuals except the operators of the system. In this case, the patent of the hardware and the copyright of the software are closely guarded. If a few key elements in the program were altered, there would be economic upheaval, but it increases the possibility for computer crime.

Likewise interactive videotex gives subscribers the right to access and use copyrighted materials provided by a data bank. This system was born in a monopoly context with Prestel, first developed by the British Post Office, followed by Oracle DGT in France, which developed Teletel (now popularly used under the trade name of Minitel), and Bildschirmtext, originated by the Bundespost. In all cases, the videotex projects were subsidized heavily by the PTTs. These systems were supplied without adequate market analysis and have not all been fully successful in revenue terms except Minitel. But all of them have met the general rules of their respective countries regarding protection of data referring to natural persons. But if copyrighted materials contained in printed encyclopedias are made available or scientific and medical information can be accessed, the user gets the materials only by subscribing to the system. In such a case, payment of royalties for the use of copyrighted materials becomes the responsibility of the PTT or the telecommunications authority that provides the system.

When the United States amended its 1976 Copyright Act, it explicitly granted copyright protection for computer software. The amendment involved the definition of a computer program and limitations on exclusive rights. A program written with a readable source code (FORTRAN, COBOL) was implicitly covered under the act. But a program written with object code or machine-readable language is directly processed by a computer and the enactment had to be explicit. In the case of *Apple Computer, Inc. v. Franklin Computer Corp.*, the First District Court ruled that the object code is not readable by persons and therefore is not copyrightable. This was reversed in the Court of Appeals. Technology has had diverse impacts on the copyright act in that decisions for protection have varied.

In the case of *Whelan Associates, Inc. v. Jaslow Dental Laboratory, Inc.* in 1986, Whelan disputed the use of its software by Jaslow, which is a manufacturer of dental devices. Whelan developed a custom program for their marketing. The agreement between the two companies was that Whelan would design and install the program for Jaslow Labs, after which Whelan could market the software to other dental laboratories. Whelan wrote a program called Dentlab in a computer language called EDL, so that it could operate on IBM series one machines. Jaslow then developed a program in BASIC language for computers used by small dental firms. This program became the copyright infringer in this legal connection. The program was called Dentcom, and Jaslow claimed it had been developed independently. Whelan sought an injunction, and the district court ruled in favor of Whelan on all counts, finding the structure and organization of Dentcom substantially similar to Dentlab and therefore a violation of Whelan's copyright. The difficulty stems from the diversified technology. For example, a computer program may be imbedded in a machine and thus qualify for a patent classification, or it may be imbedded in a microchip and thus qualify for the semiconductor classification, or it may be recorded on a magnetic tape and thus qualify for a copyright classification. Even within a classification, second-generation problems have appeared as shown in the *Whelan Associates, Inc. v. Jaslow Dental Laboratory, Inc.* case. The U.S. appellate court for the Third Circuit held that the structure of a computer program was copyrightable, thus highlighting the distinction between copyrightable expressions and non-copyrightable ideas.

The *NEC Corporation v. Intel Corporation* case of 1986 concerns yet another case of technological advance, that is, a silicon chip one centimeter square on which a computer program unit is located. A microcode is protected at the level of maskworks by the U.S. Semiconductor Chip Protection Act of 1984. Intel sold its microprocessors before the act came into effect. NEC developed similar software and sought copyright exemption from Intel. The negotiations failed, and NEC brought action in the U.S. District Court in December, 1984, claiming that it had not infringed Intel's copyright. Two months later Intel made a counterclaim for infringement of copyright by NEC. The basis of NEC's defense was that a microcode is not software but hardware, which is not protected by copyright, and that its product is not substantially similar to Intel's. NEC claimed that the idea and expression in a microcode are inseparable. Intel countered by stating that the expression of the idea was similar.

Because of technological process, software copyright laws are in confusion. In some cases, judges have refused to grant copyright protection to how programs look and act on a computer screen, holding that the software's utilitarian nature falls outside the category of artistic expression covered in copyright laws in the United States (Waldman 1988). In other disputes, jurists have extended copyright protection to the "total concept and feel" of programs. Apple Computer took this stand in its suit against Microsoft and Hewlett-Packard Co. Apple's copyright law suit is seen as an effort to lock in a technical lead in software in that it is indirectly challenging the efforts of its biggest rival, IBM, to incorporate fancy display graphics similar to the popular Macintosh. Many computer suppliers view Apple's efforts as an attempt to suppress competition and stifle the growth of graphic standards in the computer industry.

This suit is as much a problem of technology as of copyright. It cuts right to the heart of the most crucial dilemma facing the computer industry, which is the conflict between protecting innovation and the need to follow industry standards. Although inventions and inventors have to be protected, the law has to be flexible enough to promote evolution and competition within the industry. Too extreme protection of intellectual property would have a negative effect on improvement of products and standards. Too little protection has a negative impact on incentives for invention. The regulators must find the right balance. Rapidly changing technology should be in the public domain, rewarding the inventor by higher prices and government subsidy. In the United States copyrightable material is limited to expressions that may or may not be derived from common ideas. Therefore, Microsoft and Hewlett-Packard argued that any similarities between their software and Apple's are attributable to the common notion that each program is intended to make computers easier to use. Ambiguous decisions are given in different cases. In 1987 the Atlanta federal court ruled in the case of *Digital Communications v. Softklone Distributing Corp.* that copyright protection must be applied to "the placement, arrangement and design" of words on a computer screen. After this decision, the defendant reprogrammed the screen displays and marketed basically the same program.

In transborder trade and exchange of information, protection becomes even more difficult than in a given domestic situation. Most countries in Europe had amended their laws three times before 1987 to keep pace with changing technology. In particular, this is true of Sweden, the Netherlands, Denmark and Austria. The common characteristics are that they cover a wider range of products, hence simplifications of laws is aimed at; a greater amount of differentiation of sectors for data protection; a trend in favor of self-regulation; and an increased use of civil sanctions as a means of enforcing protection.

As a consequence of increasing legislation, there is a growing use of bureaucracy for enforcement and an increase in corresponding costs involved. Small businesses are wary of the costs and the time involved in complying with the laws. Greater flexibility and liberalization of laws governing transborder access to data flows and data banks as well as to software programs are needed if all countries are to share equally the fruits of technological progress. Sectoral differentiation of information stored in computerized data banks will help to ease the problem. Such differentiation can be based on the sensitivity of the information; for example, police records and population files may be more strictly regulated than information regarding science and technology that is demanded for newer applications. While protection agencies are still perceived as necessary for effective control of intellectual property infringement, information users should not be impeded in their research process.

As Japan's technology catches up with America's, scientific knowledge has begun to flow in both directions. In an article entitled "Who Are the Copycats Now?" *The Economist* (May 20, 1989) cites data to show that Japan is no longer merely a borrower of other people's technology. Payments made by Japan for purchase of foreign technology have risen over the past two decades from $2.7 billion in 1970 to $3 billion in 1985 at constant prices. But in the 1980s Japanese firms have also begun to earn handsome sums in the same way. By 1985 Japanese inventions accounted for 31 percent in communication equipment and 33 percent in office computing. There are problems with measurement of the relationship between innovative technology and the establishment of intellectual property rights. The fact remains that as a country becomes more self sufficient in technological prowess, its imports decline, and Japan has a surplus in royalty and payment fees in several products, including textiles, chemicals, iron and steel, and automobiles. It also is pouring more investment into nonmilitary R & D. In design and production of 4-megabit dynamic random access memories (DRAMs), Japan is competing vigorously with few competitors in the world. This DRAM design and production is what will form the memory for the next generation of computers. In the U.S., Sematech is a consortium of firms partly financed by the federal government which is attempting to compete in computer memory production and design. But Sematech excludes foreign companies from its cooperative research. There is also a relationship between technological superiority and military spending. Even high definition television, which is initially designed for civilian use, will enable the launching of missiles from video displays for fighter aircraft.

U.S. companies are beginning to exercise wider curbs on pirating of some technology but by no means all. Taiwan and a few other nations have begun to clamp down. After the incident with Apple Computer, Inc., Taiwan decided to move away from being the world's pirate capital. China is now providing protection from piracy of imported computer software. In May 1989 a Chinese delegation signed a bilateral agreement with the U.S. Trade Representative to cover computer software by law. China was accused by U.S. computer manufacturers of being the most rampant violator of copyright and even after the agreement was signed, the piracy of computer programs continues. However, Brazil and India have also been marked for infringement under the 1988 Omnibus Trade Act.

In the most comprehensive federal effort, the United States is close to establishing a global consensus on a code for protecting intellectual property rights, including trade secrets. Negotiations are being stalled at the level of the General Agreement on Tariffs and Trade (GATT) by India and Brazil. Thailand also is considered a prime offender in the intellectual property debate. Computer software is at the heart of the conflict with Third World countries.

Over the last decade there has been an increasing growth in the volume of intangible services exchange at a global level, and many of these services embody intellectual property. A report to the U.S. Trade Representative in 1988 estimated that out of total sales of $1,114 trillion of information-intensive products in the United States in 1986, 50 percent were directly affected by intellectual property rights. The highest concentration was in computer software and the entertainment industries. Worldwide losses due to inadequate intellectual property protection were estimated at $23.8 billion in 1986. U.S. firms incurred identification and enforcement costs for global protection amounting to $271 million in 1986, about 1.14 percent of infringing sales. Whereas these costs appear small as a percentage of sales, in absolute terms they contributed about $40 billion to the U.S. balance-of-payments deficit of in 1986.

The impact on the balance of payments of information-intensive products is not easy to evaluate, not only because they are traded as intangible, but because they cut across sectors of economic activities, making delineation difficult. Software development, data base management, and telecommunications are core elements for international financial services, so that attributing values for trade statistics has to cut across borders of economic sectors (Reidenberg 1988).

The GATT framework is geared to trade in raw materials, manufactured goods, and merchandise. It has shown no inclination to cover a growing and dynamic part of international trade which is composed of services in general and information services in particular. Even after the commencement of the Uruguay Round of GATT, the focus has been on short-term issues of infringement and dumping in the context of copyright and trade agreements. It may be useful, therefore, to distinguish between the traditional and new forms of intellectual property.

The failure of countries to protect the intellectual property rights of each other's citizens and corporations has to be rectified by an international organization like GATT, failing which several types of losses will be incurred by the originators and might serve as a disincentive to trade in intellectual-property-embedded goods and services. Some of these losses represent transfers of intellectual property from legitimate producers to infringers and consumers. To some extent these losses are manifested in the world economy, inasmuch as counterfeit products are considered good substitutes for legitimate products by users, so that there will be losses in sales revenues of firms. These diminishing returns to producers reduce the incentives for investment in new products that can be copyrighted. This involves a loss of social welfare because new products will be available in smaller numbers in the future. The same principle applies if such infringement affects the goodwill of the company whose copyrighted product is subject to violation. This is considered as economic harm to the exporter and creates a negative effect on the exporting country's balance of payments.

In international trade, infringement of intellectual property gives rise to aggregate global losses caused by the following factors:

- Export Losses
- Sales never made
- Sales lost relative to previous sales
- Future export sales at risk
- Loss in domestic sales substituted by infringing goods imports
- Loss of revenues from unpaid royalties
- Reduced profit margins
- Uncovered research costs
- Enforced reduction of production equipment resulting from above-cited losses.

Losses emerging from international trade in copyrighted products increase because the technology available to infringers, such as computer networks, modems, audio and videotapes, very small aperture terminals for receiving data from satellites, and videotext equipment, like Minitel, all offer greater opportunities for the free flow of information-intensive products. Exercise of control over such free flow in favor of copyright protection is frowned upon by political activists who consider such control a denial of individual rights. The political, economic, and technological interests involved in the provision of intellectual property goods and services that are tradeable are less institutionalized and more flexible. While there is competition for the global market among producers and vendors, the outcome becomes uncertain in light of the copying facilities available at low cost on a worldwide scale (see table 1, taken from the Report to the USTR No. 332-245, 1988).

If GATT negotiations proceed along intended lines, the outcome may be a substantial liberalization of controls over intellectual property violations. The United States is seeking liberalization in services trade. Computerized information services and exchange of knowledge-based information from data bases are a major component of such services trade. Europe has joined forces with the United States in liberalization of services trade. The only opposition seems to come from the developing and newly industrializing economies, which have been violating copyright to a large extent. It seems paradoxical then that liberalization of services trade may result in worldwide economic losses caused by copyright violation, which in the long run will reduce the volume and value of aggregate trade in services. The GATT is now confronted with this paradox, as are those countries that produce the largest amount of copyrighted materials. On the one hand, these countries are pushing GATT for free trade; on the other, their domestic policies are placing greater restraints on copyright violations.

Increased international competition in computerized, value-added services and products embodying copyrights will lead to a greater incentive for newer forms of research dissemination and thereby reduce the demand for protection of copyright in trade. The degree of competition for *supplying* copyrighted products and services internationally will determine the degree of liberalization of rules governing such trade, thereby making it less cumbersome for GATT to negotiate multilateral agreements. The initial round of negotiations for free trade in information services may not be stalled, but future agreements will depend on suppliers who enjoyed monopolistic profits in the past through protectionist policies and on consumers who want all regulations governing copyright protection removed.

With most computers attached to the world's high-speed telecommunications network, and through integrated systems digital networks (ISDN), intelligent terminals will be found on millions of office desks and in many homes linked to each other. In such a case, the information in a computer file will either take the form of a "club good" (explained earlier) or a public good with no exclusion. When such a file enters the trading system and is accessed across territorial boundaries, at what point a tariff or nontariff barrier can be raised becomes debatable. Within such an electronic trading system, in which pricing is practically nonexistent, the designing of an appropriate royalty system is next to impossible. The only time a charge could be effectively levied would be when there was a user willing to pay for getting the material out of the system. Therefore, liability for copyright is incurred within the computer network itself. Physical control of the material is required to prevent reproduction. Computer copying is easier than photocopying, which makes evasion of royalty payments equally easy.

The only other alternative for protection of copyright is through the communications industry. The vendor of a database can do no business if he does not sell the data. To make his database more competitive, the vendor has to update his information faster than his rivals or offer unpublished content. In the absence of agreed definitions and in view of exchange-rate fluctuations, many businesses do not keep a record of their trade in information services or are unwilling to disclose data regarding purchases and sales. The common carriers and the multinational corporations are unable to account for the various types and densities of traffic being transmitted over leased dedicated circuits.

Table 1. Worldwide losses of revenue resulting from intellectual property inadequacies, by industries and by degrees of loss, 1986

Industry	Loss ($,1000)	Number of firms reporting— No loss[a]	Some loss	Total
Aerospace	119,800	2	5	7
Building materials	738,550	0	6	6
Chemicals	1,334,250	3	18	21
Computers and software	4,130,164	6	25	31
Electronics	2,287,805	6	11	17
Entertainment	2,060,450	0	12	12
Food and beverage	86,300	2	8	10
Forest products	664,755	0	7	7
Industry and farm equipment	621,700	1	9	10
Metals and metal products	291,500	1	6	7
Motor vehicles and parts	2,194,490	0	4	4
Petroleum refining and related products	1,295,000	3	6	9
Pharmaceuticals	1,908,660	0	10	10
Publishing and printing	127,790	0	11	11
Rubber products	511,200	1	4	5
Scientific and photographic	5,090,100	1	6	7
Textiles and apparel	251,489	0	11	11
All other	151,200	0	8	8
Total	23,845,223	26	167	193

[a] Includes firms reporting negligible losses.

Source: Responses to the Commission's Questionnaire to Companies That Benefit from Intellectual Property Protection.

The role of GATT becomes tenuous in the face of such uncertain availability of data. A special international forum was convened in Geneva in April 1988 to discuss trade in telecommunications services as a result of the increasing attention being given to telecommunications in bilateral, regional, and multilateral trade in services negotiations. While it is widely accepted that telecommunications is a key factor in economic development, the tradeability of telecommunications services is far less understood and accepted. After the preliminary meeting of GATT at Punta del Este, the United States introduced a provision for expanding and rethinking the framework of "first generation" problems associated with the tangible aspects of intellectual property. The objective is to make Third World countries accept basic copyright protection.

Services trade has been valued by GATT at $300 to $400 billion annually and covers a wide range of services. The services negotiations are proceeding on a separate track from goods negotiations. This group is called the Group of Negotiations on Services (GNS). Its main tasks are first to define services and provide methods for measuring them. Second, trade concepts applicable to services have to be defined. Third, sector coverage has to be described. It will also review existing practices that limit the expansion of trade in services, so that there will be a better understanding of what constitutes a barrier to trade in services.

The problem for GATT is accentuated by the fact that the ITU's International Consultative Committees have developed necessary standards for interface among computers and between computers and satellites that have enabled speedy extensions of networks across national boundaries. The reason for the problem is that a trade agreement under GATT could lead to additional rules over telecommunications providers even though the agreement is intended to liberalize the situation. If GATT becomes involved in telecommunication services, it will have to coordinate its activities with ITU. What then is the common ground between trade in services and telecommunications? Governments generally intervene to a greater extent in services than in goods (Richardson 1988). The GNS is trying to delimit the area in which such intervention occurs.

Liberalization through GATT should cover access to domestic markets, but this has to be balanced with the policy objectives of national governments. The concept of trade in services recognizes that the establishment of a commercial presence and direct foreign investment may be vehicles for the delivery of a service across national frontiers. The temporary movement of business persons across borders may become necessary for trade in services to take place. The key underlying principle for trade in services is "national treatment," which means that domestic and foreign firms will be treated on the same basis.

Therefore, reaching any consensus in GATT on new trade rules for computer networks inevitably will mean that policymakers will lose their power to design domestic regulatory policies that meet their unique national requirements. The consensus will depend on the ability of governments to adjust their own policies to suit international requirements. For this purpose, both GATT and ITU will have to allow for a preconsensus phase to harmonize regulations in member countries.

The significant point that emerges is that if adequately and effectively protected, intellectual property will promote international trade and transfer of technology. If it is not effectively protected, then it is better to permit free access to information despite the fact that intellectual property is the basis for international competitiveness. At present, owners of intellectual property find themselves encumbered by laws and regulations limiting market access and repatriation of profits (Kedanren 1988). GATT's role should be the reduction and eventual elimination of trade distortions due to the absence of a settlement mechanism for intellectual property disputes.

The present international regimes for protecting intellectual property rights, that is, the Berne Convention, the Paris Convention, and the Universal Copyright Convention, have not reduced the extensive losses to industry worldwide. The conventions were never intended to be used as enforcement mechanisms for intellectual property rights and do not provide bilateral or multilateral dispute-settlement provisions. The United States uses section 301 of the Trade Act of 1986 to encourage countries to improve their protection of intellectual property rights. The European Economic Community (EEC) instituted proceedings against Indonesia for record piracy and withdrew Generalized System of Preferences (GSP) privileges from Korea for discriminatory intellectual property protection for European companies.

The objective for the Uruguay Round of GATT is to produce a multilateral code called the GATT IPP (intellectual property protection) that eliminates trade distortions caused by infringement and misappropriation of intellectual property. The negotiating clause clearly states: "Negotiations shall aim to develop a multilateral framework of principles, rules and disciplines dealing with international trade in counterfeit goods." The integration of international intellectual property into the GATT framework will supplement existing international intellectual property provisions. The negotiation of a GATT code would be more effective than merely amending existing GATT articles. The GATT will have to introduce a mechanism for examining whether national intellectual property laws are barriers to legitimate trade.

In the ultimate analysis, even with a GATT charter on IPP, the effectiveness of the system will depend on how individual owners of intellectual property will have to monitor markets and detect infringement. However, it is obviously impossible for the owner of copyrighted literary works, scientific information, and computer software to monitor their piracy in a global market where transmission is discrete over computer networks. No matter how stringent a code is devised under GATT's IPP, its enforcement will depend on national governments, which in turn may not have the technology to detect computer crime.

There is a growing and alarming vulnerability of computer systems and of persons relying on them. Simple passwords do not stop technobandits from breaking in by phone. Encryption of information and programming the computer to accept only authorized phone calls are now being used to reduce this vulnerability. Computer networks and the proprietary information they handle are assets for a corporation. The potential for piracy is greater in the service industry. Every workday U.S. computer networks transmit $1 trillion among financial institutions, which is 25 percent of the U.S. GNP. Consequently a new industry is now growing for protecting data bases with retina scanners and other devices. Changes in computer technology are making crime easier. For example, the National Aeronautics and Space Administration (NASA) had to spend three months changing passwords when hackers from West Germany repeatedly went through one NASA computer's classified data. Therefore, computer security is not only an intellectual property problem but also a management problem.

Protecting government computer systems is becoming extremely difficult. In Washington, D.C., the National Security Agency has to protect its computer sites against high-tech hijacking. But even for trade in information services, protection of intellectual property becomes an additional cost in the face of computer crimes. (See charts published in *Business Week*, August 1988). In order that GATT-IPP may become effective, detailed procedures will have to be set out to prevent violations. Fundamental principles of IPP will have to be used to determine whether domestic laws are adequate and to serve as the reference in dispute settlement. Under such circumstances, harmonization of domestic laws may not be necessary. To encourage adherence to such a multilateral framework, GATT will have to provide incentives in the form of most-favored-nation clauses. For IPP the developing countries will be permitted to delay implementation of the fundamental principles for a reasonable but limited period of time.

The proposed Fundamental Principles of Copyright Protection now being debated in GATT cover all forms of original expression. Rights under copyright are transferable, and transferees are entitled to full enforcement of their acquired rights. This has economic externalities in that it affects employer-employee relationships if the work is prepared within the scope of employment. The problem arises when a scientific or technological work is considered in the public interest. Will the GATT rules permit diminished protection or curtailment because of the scientific or social utility of the work?

The GATT does not favor compulsory licensing where legitimate needs of the copyright owner can be met by voluntary actions.

The layout design and its incorporation in a semiconductor chip are also to be protected under the GATT's Fundamental Principles. The protection covers the rights of sale and distribution of the semiconductor chip product. The protection is for a term of ten years from the date of first commercial exploitation anywhere in the world or from the date of first registration. Reproduction of a layout design is to be permitted whenever it is done for purpose of teaching, analyzing, or evaluation of concepts embodied in the design.

Innovation is indispensable to the semiconductor industry in its development. Protection of a chip layout design serves as an economic incentive for its creation. Several significant advances have taken place with respect to international protection. The United States and Japan have each adopted sui generis forms of chip protection. The Council of Europe also adopted a directive in December 1986 for the legal protection of topographies of semiconductor products. WIPO has prepared an international convention under which semiconductor integrated circuits could effectively be protected through the national laws of treaty members. Continued innovation in this industry is threatened by the pirating and copying of layout designs. The technology of pirating is so low-cost that it is difficult to prevent its use. But R & D investment in developing an efficient design involves considerable investment. Front-end costs are so high that piracy inflicts economic harm on the person or firm that originally produces the design.

Likewise proprietary information is also being considered for protection under GATT. This is the information generated by businesses or individuals that is required by a government to be disclosed as a condition for registration of a product, including secret technical know-how and records of secret business information. In the United States the freedom of information law requires disclosure of such information in part to the public, and in Japan to environmentalist groups. Such information is disclosed as a part of product registration. All such information needs to be protected according to the proposed GATT principles.

The U.S. Copyright Office ruled in June 1988 that computer software copyrights also protect the way information is presented on a computer screen. This helps companies that, like Apple and Lotus, find their products appearing in rival programs. Conflicts emerging from copyright protection have an impact on trade rules, as witnessed by the European Economic Community's trade sanctions against Korea for refusing to extend the same protection of intellectual property rights that it accords to the United States. This means South Korea will pay an additional 5 percent customs duty on its exports to the EEC, costing the country $50 million extra each year. While economists continue to debate whether IPP reduces or enhances competition, the justification to uphold it lies in the fostering of innovation.

But cultural differences make trade distortions difficult to ease in the realm of IPP. For example, the U.S. system sets up a legal monopoly to give the innovator and his or her company a chance to obtain a comparative market advantage. The Japanese system, on the other hand, is aimed at avoiding conflict and promoting cooperation, which is part of the Japanese culture. Cross-licensing is a disadvantage for small companies competing with large ones (*Wall Street Journal,* July 12, 1988, p. 27). Therefore, the United States and Japan have formed a working group to review U.S. complaints about infringement. Similarly a copyright agreement emerged on May 17, 1988, between European, U.S., and Japanese industry representatives to stop the theft of intellectual property. Their recommendations to the GATT, if adopted, will go a long way in reducing international trade distortions.

There are potential difficulties in achieving an intellectual property code in the GATT. The first concerns the issue of standards setting. GATT has not traditionally been a standards-setting body. It has relied instead on national treatment and most-favored-nation (MFN) principles to achieve its goals. National treatment achieves nothing in the absence of standards. For that reason, the United States has stated its intention to bring standards-setting duties, particularly in the industrial property area (patents), to the GATT.

Preliminary recommendations from a number of business organizations suggest that standards negotiations in the industrial property and copyright areas should not rely exclusively on existing WIPO conventions or the UCC. Instead it has been argued that countries use the GATT negotiation opportunity to build a consensus for stronger, more uniform principles and standards. This process must include safeguards, however, to ensure that existing standards are not reduced. Once these principles and rules are established, negotiators must then determine how they will interact with existing intellectual property conventions. The relationship between GATT and WIPO must further be clarified. The United States, of course, must also confront the possibility that consensus standards might conflict with—and thus require changes in—U.S. law. Although the standards issue poses many difficulties, it also holds great promise for improving world protection.

Intellectual property rights also pose a conceptual problem for GATT. Since its origin after World War II, GATT has been in the business of breaking down barriers to trade to create a level playing field for all countries. Intellectual property rights in some sense do the opposite. Whatever one thinks about their legitimacy, intellectual property rights establish special privileges, indeed monopoly privileges, for a selected few. This constitutes a rather dramatic shift in orientation for GATT and makes it all the more pressing to establish how intellectual property protection is in the interests of all members and of the global economic system.

This brings us to the most difficult problem confronting supporters of a GATT code for intellectual property rights—how to convince all concerned that such a code is in their interests. Not all, of course, accept the economic rationales for intellectual property rights. The South, or underdeveloped countries, in particular raises serious questions about protection of technologies that promote social welfare.

Similar differences occur over copyright protection. The developed countries have acceded to some cultural and developmental arguments and priorities by permitting, in effect, global "fair use" clauses in the Berne Convention and the Universal Copyright Convention. Commercial pirating remains rampant, however, and many in the developing world still view such activities as legitimate in a developmental context.

Neither side, however, has amassed much evidence to support its claims, and it is unlikely that these arguments will ultimately determine the fate of a code. Arguments and divisions of this sort do, however, illustrate one important reality about the coming negotiations. An intellectual property code cannot be successfully negotiated outside the broader goals of the Uruguay Round.

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Session 2.2

Country Overview II

NOTES

Deregulation of Telecommunications Services Market and the Perspectives in Korea

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1. ABSTRACT

Discussions are going on hotly in Korea for the restructuring of the telecommunications services industry. While significant steps have already been taken by the government initiative regarding the value added services, there are controversies over the timing and extent for the introduction of the competitive basic services. If the government decides to introduce the competition into the basic services sooner or later, it would be the first fundamental telecommunications reform of such dimension in the circle of the Newly Industrialized Countries.

2. TELECOMMUNICATIONS SERVICES ENVIRONMENT IN KOREA

2.1 PLAYERS IN THE MARKET

Korean telecommunications had its centennial in 1985. The first subscriber was the last king of Lee dynasty, Ko-Jong and since then the industry has been through the vicissitudes marked by the long period of Japanese reign, the Pacific war and Korean war. As in most other countries, the telecommunications had been held strictly within the realm of governmental authority until the service provision functions were seperated in 1982 from the government over to the telecommunications organizations : Korea Telecommunication Authority (KTA) and Data Communications Corp. of Korea (DACOM). KTA is a public company, which is responsible for telephone and telex services and the government has the 100% equities of the company, while DACOM is a private corporation supplying the public data network services and leased data circuits. Three other carriers were established and authorized by the Ministry of Communications in 1988 as you will find in the Table 1.

It was only very recently that the private sector was allowed to engage in third party communications by a series of liberalization measures and now the private forces should be counted in dealing with the Korean telecommunications. More than 100 private organizations are registered for the information services provision and these organizations can offer the message switching services.

Still the infrastructural network is owned and operated by KTA, though DACOM was allowed and has been struggling to own its facilities. The government, say the Ministry of Communications, carries out the regulatory function.

2.2 EVALUATION OF THE MARKET

In recent years the Korean telecommunications made several remarkable achievements, which seem to presage a new era of communications in Korea. In 1987, the total telephone network capacity exceeded 10 million lines and this compares very impressively with less than 3.5 million back in 1981.

The efforts to advance the communications technologies have been made at the same time and in 1987 the development of the electronic exchange, TDX-1, by the self contained technologies added Korea to the list of the exchanges producing countries, though nominal. The data communications services, yet in a rudimentary stage, are also growing fastly. Since 1985, the subscribers to the public data network increased to about 6,500 in 1989 recording the annual growth rate of roughly 100% and by the end of 1989 the leased data circuits supplied numbered around 56,000 marking 40% in annual growth since 1985. Despite the impressive velocities of the development that the Korean telecommunications has demonstrated these years, still it would be premature to seriously compare the Korean achievements with those of the advanced countries in many ways. According to a study made by an industrial reasearch institute in Korea, the expenditure for telecommunications services by an average Korean was 65 U.S. dollars in 1986. In the same year, U.S. expenditure averaged 576 U.S. dollars and Japan, West Germany and the United Kingdom fell on somewhere between 200 and 260.

Another aspect that can make the Korean situation sound a far cry would be in the value added services areas. The total revenue of the value added services industry including the information services in 1986 was only 300 million U.S. dollars, while U.S. revenued 22 billion and something in the same year. If you talked about Korean value added services market in 1986, you were talking about something smaller than one seventieth fraction of U.S. market that year. Though the Korean telecommunications are making a fast progress these years, it would be fair to say that it will be long years before the Korean market reaches around the level of the advanced countries.

3. LIBERALIZATION PROCESS

3.1 LIBERALIZATION ACHIEVED SO FAR

'Liberalization' is a hot word in Korea these days. As the private companies are beginning to eye for the informatization or business out of it, the value added services, which used to be the monopoly of the carriers, became an item that the most conglomerates and big companies in Korea cherished in their mind for their next new business. Entering the 1980s, the government has posed a quite liberal attitude toward the telecommunications industry and has taken a strong initiative toward the liberalization.

The attachment of the subscriber provided telephone set was allowed in 1981, which is now common around the world but was quite radical back then. This small liberalization is now considered to have contributed greatly to making the country one of the major exporters of the telecommuncations terminals. The separation of the service provisions from the regulatory functions was implemented in 1982 by establishing KTA and DACOM.

The liberalization efforts were made from 1984 to allow more opportunities for the private sector to participate in the value added services. In 1984, a series of Acts were put effective : the Telecommunications Basic Act, Public Telecommunications Business Act, KTA Act and the other accompanying supplementary decrees. The information services were mentioned by the law for the first time in the Public Telecommunications Business Act. Roughly the framework of the 1984 Acts would be comparable to that of 1972 Japanese telecommunications laws. All the services that consist in the transfer of third party messages remained in the monopolistic domain of the Public Telecommunications Organizations. Thus the use of leased circuits was very restrictive and confined to the internal use within an organization. Only the information services, say the data base and data processing services, were allowed to use the leased lines with the third party customers. However, there are some provisions in the law delegating to the Minister of Communications the power of identifying and exercising the exceptions and it was by exploiting these provisions that the Ministry has taken the successive measures of liberalization since 1984. The liberalization measures consisted mainly in broadening the application of the shared use of leased lines, allowing the message switchings to the information services providers and the attachment of multiplexers for the private network. The four successive measures, as can be found in Table 2, in the form of Presidential and Ministerial Decrees have liberalized the industry to the level comparable to that of Japan just before the 1984 telecommunications reform. Considering Korean telecommunications industry environment and development stage, those liberalization measures can be said to be drastic and there are some critics who say that the exploitations of the exceptional provisions have gone too far to the extent that can make the whole framework of the 1984 laws shaky. However, if there is a concensus among the policy people, it would be that there needs to be a restructuring of the law system in order to accomodate the further liberalization, which would be comparable to the level reached by the countries with the most liberalized systems.

3.2 FOREIGN FACTORS

The U.S. pressures were made when the Korean policy makers were contemplating on a structural change of the telecommunications service industry. The U.S. interests in the Korean market is not a thing to be looked over by Koreans when one considers the importance of the U.S. market for Korean telecommunications equipment manufacturers. Korea was identified in February 1989 by US government as Prior Foreign Country along with the European Community in telecommunications.

The U.S. requirements, as were outlined in the course of the February consultations, include some areas that may be too much imposing to a market, which has just begun its liberalization but the general direction of liberalizations seems to coincide with that in contemplation by the Korea policy makers. Many people in Korea concerned in the telecommunications industry think that there would be some areas where a breakage in the services market is worried that a 'Once for All' approach may invite. What the policy makers in Korea are aiming at the moment is a new law system and this quickly, which can accomodate a structural change comparable to those of the most liberalized three countries : United States, Japan and United Kingdom. While most of the liberalizations would be made directly with the introduction of the new law system, there can be some minimal areas that the new system may design to introduce further deregulation at a later time to pursue a phased approaches taking care to eliminate any possibility of jeopardizing the whole market mechanism.

It can be viewed that there would be no major points of difference between the two countries in the future liberalizations for the market, as long as both parties succeed to understand and recognize each other's situations and needs.

4. CONSIDERATIONS IN THE CHOICE OF NEW REGIME

4.1 SOME OF THE CONCERNS IN THE WAY

There seems to be no palpable objections against the free entry in the value added services market and a significant liberalization has been already achieved in the area. As has been pointed out in the discussions made before the industry reforms of the most liberalized regimes, the free entry is not all for the free and fair competition in the services. What can be more important is the competitive environment, where all the participant competitors compete in an equal and fair terms across the board. It is understood that the competition in the basic services is an alternative not only for the elimination of X-inefficiency of the monopoly and distortion of the market mechanism usually associated with the monopolistic system, but also for the equal footings for all the value added services, if you really care for the development of the value added services market.

However, there exist formidable oppositions against the competitive basic services. The same situation is prevailing in Korea as had been in other countries in the previous period for the industry reform. There are blocks of pros and cons and the cons are holding on to the consumer protections, universal service and the social integration that the monopoly system claims to have protected successfully so far and that no other thing can replace.

Quoting the EC Directive on Competition in the Markets for Telecommunications Services, consumer protection does not make it necessary to restrict freedom to provide telecommunications services since this objective can also be attained through free competition. The liberalized countries did not adopt the competition in basic services because they no longer sticked to the universal service but because they believed that the competition might serve the theme more efficently. ISDN, often suggested as the only and every network in the future, does not foretell a single network and operator. Rather, it can encourage plural operators through its standardization efforts throughout the world.

4.2 ONGOING DISCUSSIONS IN KOREA

Besides the arguments dealing with the general issues around the liberalizations, in Korea some assert that the competitive basic services are premature, pointing out the fact that the telephone service dissemination in Korea, 32 subscribers per 100 people in 1988, is yet below the level of the advanced countries.

It should be pointed out that important here is not how long the monopoly can be sustained and tolerated but what the competition can do for the improvement of the situation now . About the timing, nothing can be a better reference than the introduction of free competition in value added services. Now the private sector is eager for the value added services as their business and assessing from their resources and experiences, one can say that they would be capable of developing their own paths in the industry, if given proper environment. Many efforts are being made to build a fair competitive environment for value added services, such as Open Network Provision efforts in Europe and monopoly prices regulations, but these efforts would be usless unless the monopoly is put in a competitive situation and celebrated with the motivation to be efficient by itself. Any carrier, if it really cares for the value added services industry and is eager about the healthy growth of the market, should show its seriousness by the readiness for the competition in its native area.

5. DACOM EMERGING AS A SECOND CARRIER

5.1 DACOM RECOGNIZED AS 2ND CARRIER

Thinking back, the establishment of Data Communications Corp. of Korea was quite a unique decision to be made in 1982. In view of the digitalization of the communications technologies, this decision may appear a little absolete now. However, at the time of the establishment the data communications services were unknown to the public users and the government found it urgent to nurture the market employing the vitalities and flexibilities of the private company. 40% of DACOM's equities are owned by the government and the rest shared among private sector. So far DACOM has carried out the social function as carrier in data communications offering the public data network and leased data circuit services to the public. One of the significant contributions of DACOM would be that it has helped the private sector have a taste for value added services. Though not profitable yet, DACOM has so far continued to desseminate the new media services, such as electronic mail and data base services. If the ongoing boom for the value added services is attributable to several factors, DACOM's efforts should be counted as one. Now that the competitive basic services is a hot issue around the world, the existence of a special carrier like DACOM is enriching the governmental choice over the future shaping of the market.

It is an asset to a nation to have a serious candidate for a 2nd carrier, since the basic services provision, by its intrinsic nature, should still serve its public goals and once the competition is to be introduced, it should be effective. It will be a safe choice for a country of Korean size in both economical and geographical sense, to start with duopoly in the area as the United Kingdom did. A series of measures by the Minitry since 1988 clearly shows that the government is testing the idea of a competitive basic services. The Ministry, in its public announcement of May 1988, decided that DACOM can construct and own the facilities for its data communications services. A more detailed and concrete measure was made by the Ministry in May 1989 when the decision was announced that Intelsat Business Service and MHS, the CCITT Recommendation X.400 based service, should be given to DACOM, ending the disputes over the services between the two carriers. DACOM well understands the irreversibility of the telecommunications policy and now the contribution of DACOM to the society should be through the effective competition in basic services. Also, by this way DACOM will be able to help create a more favorable environment for the liberalized value added services market.

5.2 BUSINESS STRATEGIES OF DACOM

For the time being, DACOM will focus on the business market by offering the digital data communications services. Much efforts will be made for the construction of the digital network. IBS network, once built, would be the first physical circuit facilities of DACOM's own. IBS service is scheduled to start in the first half of 1990. The construction of the domestic long distance digital network would be the most demanding and challenging task for DACOM. DACOM plans to build a fiber optic network linking the major cities around the country to be completed by the end of 1993. Though the competition in the long distance voice communications is not at the stage of serious discussion, the completion by DACOM of the nationwide optical network will make the idea sound not so far fetched. The submarine optical cables are one of the requisites for international carriers these days. DACOM is now seeking to participate in the major projects, starting with the North Pacific Cable.

The software expertise can be one of the strengths of DACOM. DACOM has been conducting a nationwide computerization project for the government called National Administration Information System (NAIS) for 5 years. The Message Handling System was developed based on the DACOM's own technologies and resources in as early as August 1988 and was put on the market in October 1989. As a new competition in basic services, DACOM will endeavour to secure and expand its own market with lower prices and better qualities. DACOM will sure present more choices to the consumers and will help the newly liberalized value added services take the root in the market in a shortest time.

6. CONCLUSION

The Korean telecommunications liberalization will make a new and unique precedence for the countries who are considering a reform in the industry. If the liberalization turns out to be successful, the message would be that the liberalized system is applicable not only to the most advanced industries but to a country of Korean level and that the competition up and down the industry is rather a progressive replacement of the monopolistic system than the last alternative for the outworn monopoly.

DACOM is an everlasting supporter of the progressive policies and paradigms and will try to be one of the patrons for a new thinking that the telecommunications organizations also should contribute to the society through the generation of the creative profits as long as they belong to the capitalistic system.

It is probable that the 'Missing Link' in the information society can happen not only from the underdeveloped regions but also by some in the advanced blocks, which would stick to the monopoly principles. The liberalization in the telecommunications will be something that untimately would contribute to the integrity and peace of the world, not to say the prosperities of each country in that direction.

TABLE 1. CURRENT COMMON CARRIERS

COMMON CARRIER	SERVICES	ESTABLISHMENT	'88 REVENUE (M $)	AUTHORIZATION
KTA	o PSTN & TLX o Domestic & Int'l	January 1982	3,821	o Authorized by KTA Law
DACOM	o PSDN & Leased Data Line o Domestic & Int'l	March	122	o Authorized by MOC
KMTC	o Cellular & Page o Domestic	April 1988	18	"
KPC	o Radio & Telephone SVCs between Port and Vessels	January 1988	2	"
KOTIS	o Travel information and Airline Reservation	Feburary 1988	0.1	"

- KMTC : Korea Mobile Telecommunication Corp./ - KPC : Korea Port Telephone Corp.
- KOTIS : Korea Travel Information Services Corp.

TABLE 2. LIBERALIZATION MEASURES ON THE USE OF LEASED DATA CIRCUTS

MEASURES	TAKEN ON	MAJOR CONTENTS
1st	JAN. 1985	o Recognition of Information Service Providers upon MOC approval o Recognition of shared use of leased data circuits between users in a "close business relations" (eg. more than twenty percent business relationship)
2nd	JUN. 1987	o Broadening of "close business relations" definition (eg. sole shared use without no other connections) o Message Switching allowed among affiliates of "a business group" upon MOC approval ("Group VAN") o Foreign participation in information service provider allowed up to 50%
3rd	DEC. 1988	o Further broadening of "close business relations" and the scope of "a business group" (eg. sales agencies, subcontractors and above 10% business relationship) o Multiplexer allowed (9.6Kbps or less)
4th	JUL. 1989	o Third party message switching allowed for information service providers upon MOC approval o Multiplexer allowed for speed higher than 64Kbps

INFORMATION TECHNOLOGY AND NATIONAL DEVELOPMENT: ONE STEP FORWARD OR BACKWARD FOR THAILAND?

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Abstract

Information technology has brought about some development in Thailand such as in the areas of health, education, and commerce. Thailand, however, has to face the problem of trade deficits due to importation of these know-hows. Several measures are proposed so that technology is effectively transferred to the Thai people and the country can really benefit from the usage without having to pay a very high price.

I. INTRODUCTION

Many definitions of information technology exist. In this paper, the term information technology is defined as the combination of computers, electronics, telecommunications, and the human element working together to form a complete system. In this Age of Information in which information technology prevails and plays a very important part in development, those with high technological knowledge, the have's, obviously gain advantage over those with low technological expertise. It is no surprise then that the disparity between the rich developed countries and the poor developing countries seems to have been echoed around. (1) The rich countries, with their proliferations of both hardware and software, have as their target customers the poor countries, who, in return, have not much to offer in terms of balancing off the trade deficit. Moreover, these developed countries, with their affluence, can gain access to various sorts of information and can thus penetrate into every corner of life of the have nots. The vicious circle then seems complete: those who possess information possess power.

The question then is, "Since Thailand cannot escape from being woven into the global information network, what has Thailand gained or lost from this coming Information Age ? What would be some feasible policies for a country like Thailand, possibly a "newly agro-industrialized country", to face this Information Age?

II. INFORMATION TECHNOLOGY IN THAILAND: MACROSCOPIC AND MICROSCOPIC VIEWS

Information technology in Thailand can be said to operationalize in four categories following its service function. (2)

1. Information technology used for security purpose--this includes the communication system of the Ministries of Defense and Interior which is usually tactical or operational network.
2. Information technology used for public service-- the system is under the control of two institutes: the Telephone Organization of Thailand (TOT) which supervises the local and international telephone services for rural and urban areas, and the Authority of Thailand (CAT) which renders postal services, telegraph, telex, facsimile, radio telephone, VHF radio, maritime and mobile radio, leased circuit, data transmission, and mobile telecommunication units.
3. Information technology used for specialized affairs-- this is the administrative network in which each Ministry or state enterprise or private business uses telecommunications to coordinate with their regional sectors such as the Ministry of Public Health, the Ministry of Agriculture and Cooperatives, the Metropolitan Waterwork Authority of Thailand, the banking business, etc.
4. Information technology and mass communication-- this involves communication through radio, television, and printed media.

The mentioned four categories of information technology and communication system is a macroscopic overview. It one tries to specify information technology that is of daily needs for Thai urban and rural population, the technology should, as Ithiel de Sola Pool, a UNESCO expert points out, be low cost, able to reach scattering villages, and needs not be fashionably modern. The technology mentioned by Pool includes radio, television via satellite, telephone via satellite, and computer for data storage and retrieval. (3) What Pool says seems to hold true in the Thai experience except for telephone via satellite which, according to a top executive of TOT, proves unnecessary in Thailand where villages are not located in mountaineous or islandic areas. (4)

Radio and Television via Satellite

Radio and television are widely known among scattered villagers all over Thailand. Apart from entertaining purpose, these two telecommunication

FIGURE 1
NUMBER OF VILLAGES INFLICTED WITH EDUCATION AND HEALTH PROBLEMS

Problems	Region				Total
	Central	Northern	Northeastern	Southern	
-low level of knowledge and education	1,652	2,006	7,271	1,377	12,306
-health and sanitation	1,411	1,665	2,856	1,162	7,094

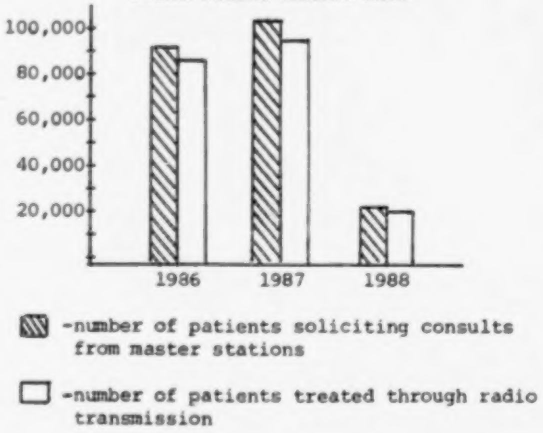
Source: The Sixth Five-Year Economic and Social Development Plan (1987-1991)

devices are practically useful for education and public health services, to mention only a few. The existent wide gap of educational accessibility among various segments of the country particularly between the rural and the urban population has been an unhealthy sign of Thai society. It was not until the Fourth Five-Year Economic and Social Development Plan (1977-1981) that the plan for nonformal education had been clearly spelled out. The Fourth Five-Year Plan stipulated that promotion of nonformal education would be listed as one of top priorities in the social and education developments, that "all existing mass media of communication must be fully utilized to support formal as well as nonformal education programs." (5) Among several nonformal education programs are, for example, Vocational Adult Education Project, Radio Correspondence and Television for Nonformal Education, and Radio Programs of Ramkamhaeng and Sukhothaithammathirat Universities.

The concept of university without walls depends much on the contributions of information technology. One open university, Sukhothaithammathirat, established in 1980, can be considered the first institute to bring university level education to the rural people in literary sense. The university does not possess any classroom physically and all the lessons are transmitted to the students through electronic media, satellite, and books. Several hundred thousand people have graduated from this university regardless of uncountable audience which might have acquired knowledge through their radio and television receptors.

Public health care is another field that makes an interesting use of information technology. Apart from utilizing computer to do the work of rural population census or mass media for health care education which is normal, those concerned have adopted a curative project aimed to help people in very barren and deserted places. This project is the operation of radio transmitter and has been executed since 1976. The concept is that at the three radio master stations (usually the hospitals) situated in the northern, northeastern, southern, and central parts of Thailand, there are doctors who will stand by and give consults as well as prescribe medicine for patients who are at the other end or the repeater stations located at the public health clinics in 47 provinces. (There are 73 provinces in Thailand, equivalent to a state in the USA.) The report of the patient's symptom is done orally by officials who work at the station. All the medication and physiological charts demonstrating parts of the body are codenumbered between the master and the repeater stations to give the doctor as precise information as possible for reciprocally precise dignoses. In case of emergency, the repeater stations can contact the master stations for urgent transportation such as helicopter and ambulance. (6)

FIGURE 2
USE OF RADIO TRANSMISSION IN RURAL PUBLIC HEALTH CARE



* The number of patients dropped in 1988 due to the efficiency and development of transportation
Source : Information Center, Ministry of Public Health, 1989.

Telephone Via Satellite

Telephone usage has been introduced to Thailand since 1886. At present, the transmission system is microwave radio with 6,000 MHz frequency, 1,800 and 2,700 circuits. The fiber optic cable will soon widely substitute the microwave radio.(7)

The status of telephone service in Thailand in 1988 can be summarized in the following table

FIGURE 3
THE STATUS OF TELEPHONE SERVICE IN 1988

	metropolitan	regional	total
-no. of telephone exchange	69	216	285
-available telephone numbers	860,000	389,000	1,249,000
-telephone numbers in use	631,000	292,000	923,000
-installation waiting list	250,000	35,000	285,000
-telephone numbers per 100 persons	11.08	0.81	2.31

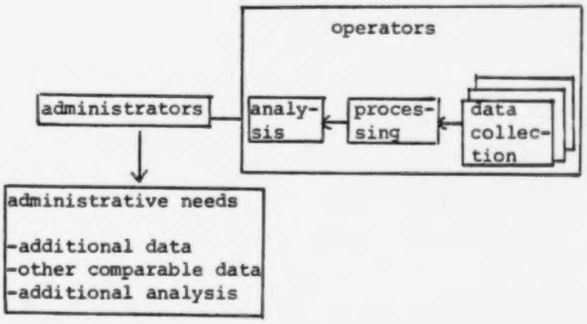
Looking at the telephone numbers, one can conclude that the numbers available are even below the subsistential level particularly in the rural areas. If telephone density is used as an indicator of economic status of a country, Malaysia has over 10 telephone numbers per 100 persons and the ratio in Japan is 50-60 number per 100 persons. (8) What is implied here is the quality of life on the average of Thai people and the discrepancy of income distribution of the total population. Nonetheless, TOT has invested 1.5 million baht for one number of public telephone in the rural areas and has currently expanded its service to the amphoe and king-amphoe levels. (The "amphoe" and "king-amphoe" are part and sub-part of a province, bigger than a district.) Installation of rural long distance telephone stations in 468 amphoes and king-amphoes where local telephone services are inaccessible enable the public in those locations to use automotic long distance service to communicate all over the country and to neighboring countries as Malaysia and Laos for a total of 1,412 lines in 63 provinces of Thailand. TOT is now executing its project on the district level, which, after the end of the project, will enable 28 provinces with 1,813 districts to have 5,439 numbers. (Each district will possess 3 numbers) Because of the huge amount of investment, the country faces the problem of fund preparation pressured by the urgent needs of the rural population to have accessibility to telephone usage. (9)

Computer for Data Storage and Retrieval

From the last decade until now, the Thai government has seriously considered the problems in the rural areas and made an effort to solve various problems through the use of computer technology. Some of these chronic problems are poverty, draught, natural disasters, lack of factors to produce effectively agricultural crops, lack of knowledge in public health and legal matters, lack of economic and commercial knowledge etc..

The Sixth Five-Year Economic and Social Development Plan (1987-1991) has stipulated its Action Plans no.4 (Science and Technology Development Plan) and no.7 (Production, Marketing, and Job Creation Development Plan) that priority and importance be given to data and information provision for the progress of the country in this Information Age. This planning is not without its predecessor. In 1979, the "National Operation Center" was set up under the control of the Office of the Prime Minister with the purpose of it being the biggest data base for the Cabinet. The activities of the National Operation Center had been frozen for a period without obvious reasons. The present government, however, considered the project very useful and resuscitated it. The National Operation Center was reopened in May of 1989. The concept of this Center is to collect data from government agencies such as the National Statistics Bureau, the Department of Irrigation, the Department of Metereology, the Office of Civil Service, the Land Reform Bureau, the Bank of Thailand, the Department of State Highway, the Security Council, etc. (10) As stated in the Seventh Five-Year Plan, the government wanted an institute that supplied production and marketing information to the rural population. The Ministry of Industry then was assigned the task of major coordinator in gathering and linking information mainly from the Ministry of Agriculture and Cooperatives and the Ministry of Commerce. (11) The National Operation Center can be said to serve both the administrative needs and the general public needs. The following chart shows the relationship between the data and the administrators.

FIGURE 4
THE ADMINISTRATIVE NEEDS FOR DATABASE



In actuality, the concept remains unimplemented probably due to its oversizedness. Each Ministry or government agency concerned either uses a mainframe, or a mini-computer, or a micro computer to store data for its own use. More important, rural people rarely gain access to these data. On their part, they simply lack the knowledge or understanding of how to ask for these data. Instructions and publicity should help solve the problem. The government, however, should provide enough database for the rural population through the connection between the mainframes in the metropolitan area and the PC's in other provinces so that the government's plan to distribute information to the public especially in the rural areas would be fulfilled other than the sole use of information for administrative purposes. Imagine a useful channel for providing information for agriculturalists. Suppose a province is famous for planting fruit x that is exportable and very profitable. The other provinces naturally would like to imitate their successful peers. What follows is a high competition, a cut in price; some might meet with unsuitable soil and surroundings and fail right at the beginning. These agriculturalists should have the right to be communicated, to be informed. The following table demonstrates the concept.

FIGURE 5
THE AGRICULTURALISTS' NEEDS FOR DATABASE

data needs	data sources
-What kind of crop can be grown on their land?	Dept. of Land Development
-On how many acres of land has that crop been cultivated all over Thailand?	Ministry of Agriculture and Cooperatives
-Trends for foreign markets and export growth	Ministry of Commerce
-Steps and methods in cultivation	Department of Agricultural Education
-Assistance rendered by other government agencies	Office of the Prime Minister
etc.	etc.

On receiving the data, the farmers should be able to make decisions. The final outcome of their decisions should be adked to be reported back to the database center so that records can be filed for further use.

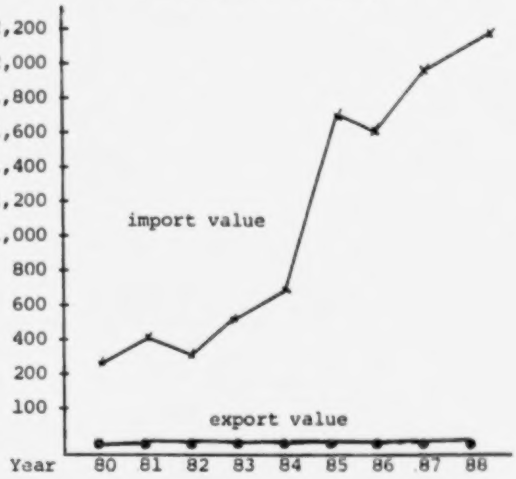
The project of national information center, if successful, will prove most beneficial to national development intensively and extensively. Nonetheless, the project needs long-term subplannings, consumes a lot of time and energy, and most important, a huge amount of budget.

Obviously, the four most needed types of information technology mentioned, i.e., radio and television, telephone, and computer, are government's subsidy for the majority of the population in the agricultural careers most of which live in the rural areas. The number of these people is estimated to be over 70 per cent of the whole population. Needless to say, the metropolitan areas, particularly the capital and its peripherals, have outpaced the poor rural areas in their consumption of information technology. In the urban areas where concentrated big businesses such as banking and finance, insurance and real estate, construction, manufacturing, transportation, etc., the use of information technology is normal and indispensable In banking business, for example, automatic teller machine, credit cards, and telebanking services have been introduced into the country for some time. There are computer networks linking all the branches of big commercial banks all over the country. In other kinds of business, apart form telecommunication usage such as telex and facsimile, the use of computer technology is popular in production, accounting, marketing, inventory, and personnel control. And it is in the private sector that reflects more clearly the discrepancy between the capital the rural areas.

III. INFORMATION TECHNOLOGY FOR THAILAND: A SIGN OF PROGRESS ?

The previous section reviews some advancement or potential advancement generated by the use of information technology in Thailand. The most outstanding role played by a developing country is usually that of an end user. Take for an example the import value of computer equipment of Thailand as compared with the export value.

FIGURE 6
COMPARISON BETWEEN IMPORT AND EXPORT VALUES OF COMPUTER COMPONENTS OF THAILAND
MILLION BAHT (1 US $ = 25 BAHT)



Source: Foreign Trade Statistics, Customs Department. (The latest data available are those of 1988)

Figure 6 reveals an enormous imbalance between the import and export value of computer computer components over ten years. If the project of the national computer center (the so-called "National Operation Center) is fully implemented all over the country, i.e., each district in 73 provinces in Thailand will possess a PC, the government will have to invest in over hundred thousand PC's for each district. Although a long-term project, these expenditures cannot be overlooked.

In actuality, the production and assembling of computer parts in Thailand have been in operation and supported by the national Board of Investment. which means several privileges such as exemption of taxation for a number of years but the purpose as stipulated by the government must be for export only. And this is the reason to be regretted. These computer factories have foreign major shareholders who see advantage of Thai low labor cost and invest in Thailand. They are heartily welcomed by the government which normally seeks employment for its population other than anything else. The Thai workers and technicians apparently are merely producing or assembling parts of a machine to be exported. They are like people putting jigsaw pieces together without ever viewing the whole picture. Real technology has not yet been transferred.

Telephone usage espansion is another factor contributing to trade deficit. It is estimated that for one telephone number, the country has to invest US $ 2,000. This is an average cost for a private phone in the urban area. If we use the relationship between the number of telephones and the gross national product (GNP) as surveyed by UNESCO to calculate the amount invested, by the year 2000 A.D., Thailand will have to pay about US $ 10 billion to provide telephones to a population of 60 million persons. At present, the per capita income of Thailand is US $ 800-900. If we adopt the policy of raising the Thai people's per capita income to US $ 2,000-3,000, by 2000 A.D., the number of telephone users should be increased by 10 sets per 100 persons, thus totaling 6 million telephone numbers for 60 million population. In 1989, Thailand has about 1 million telephones, there are about 5 million more to work on. As mentioned, each number costs US $ 2,000, so, a total amount of US $ 20 billion has to be prepared if we think only in terms of importation. (12)

The critical question seems to be, "Shall we stop importing information technology?" The answer is not a simple yes or no. The first section of this paper exempliflies the usefulness of information technology without which Thailand could not have developed this far. The country cannot afford to be both poor and ignorant. What would then be the suitable "middle path" to follow? First of all, an awareness must be inculcated in the Thai mind. Recognizing that the country has to import a lot of information technology, Thai people must think of domestic production as a substitute. This needs a preplanning from top administrators of the country. The policy-makers have to realize that since importation is still indispensable, Thailand has to be selective in its import policy. Normally, the multi-corporations of information technology will offer the so-called "technology package" consisting of the machines themselves along with engineers or technical experts, manuals, administrative personnel and eventually some funding (13). Thailand should not be tempted to buy all with several incentives offered but should make selections. The country should buy what it lacks or cannot produce and at the same time, Thai people must attempt to study the know-how from the producers or vendors. This may need government measures or policy to ensure that real technology is transmitted. To cite the South Korean exporience, the Korean government had issued a policy of building factories which were of smaller scale production than actual market demands. Depending on foreign engineers and technicians to run their small-scale factories at the beginning with the Korean trainees, the local people soon learned from these experts and subsequent factories would be built and operated by the Koreans themselves. (14) This policy of self-dependence prevails in Inida too with regards to its construction of Russian-designed satellite. India used national infrastructure and trained its local people to operate the satellite while assisted by the Russians and the Americans. (15) The conclusion from the Korean and the Indian examples is briefly the training of domestic human resources apparently is a suitable policy.

Technology moves fast, and technology coupled with telecommunications usually outpaces the knowledge and expertise of those who are end-users rather than producers. Thailand definitely has to face this problem, and the solution has to be a long-term planning. At present, as shown in figure 7, relatively very few graduates have been trained in the fields of Engineering or Information Technology compared with the fields in Humanities and Education at the university level. (16) Fortunately, the Thai government has realized the problem and has tried to modify the national education plan, for example, more students have been admitted in the fields of Engineering, or related fields, in state vocational colleges, State and private universities. Social Science or even Humanities students will be trained in some public universities to be information technologists at the post graduate level, such as students in the fields of Communication Studies, Business, Accounting, and Statistics, and Library Science. (17) In addition. the Thai government, through the National Research

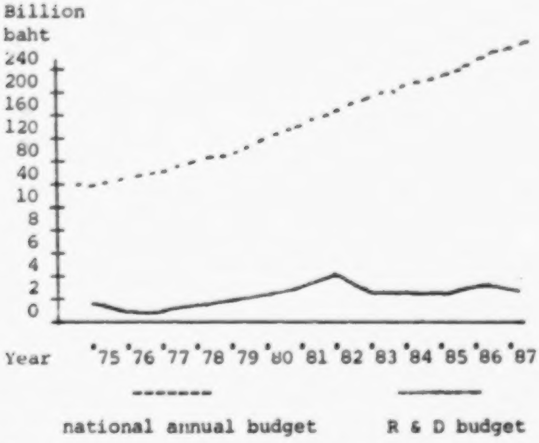
FIGURE 7
EXPECTED GRADUATES IN THE SIXTH NATIONAL DEVELOPMENT PLAN (1987-1991)

fields (per year)	state/ closed univs.	state/ open univs.	private univs.
Education	6,500	10,000	700
Engineering/ Computer/ Technology	3,000	250	110
Mass Communication/ Communication Studies	500	2,000	300

Council, is taking action to encourage university experts or professionals to express their talents in technological inventions the most popular of which is the proliferation of computer software.

With regard to the R&D, the government may probably have to allocate more budget and may possibly cooperate with the industrial sector so that research outcome can be practically put into use. At present, the Ministry of Science and Technology has established the National Center of Electronics Technology and Computer and the Science and Technology Development Board to accelerate the R&D activities to the industrial manufacturing stage. The university scholars and researchers are now concentrating on three fields of research on communication technology: electronics technology, switching and network technology, and end-user transmitter technology. (18) Probably, the Ministry of Science and Technology itself that was established only a few years ago signals the moves of Thailand to counter the Third Wave, and not to be drowned before the country reaches the shore. Hopefully, Thailand will acquire more fund for the R&D activities which since the last decade has not improved.

FIGURE 8
THE R&D BUDGET ALLOCATED TO THE PUBLIC SECTOR AND STATE ENTERPRISE AS COMPARED WITH THE THAI NATIONAL ANNUAL BUDGET



Source : National Research Council (Latest data available are those of 1987)

IV. CONCLUSION

It may remain a hard-to-realized dream that Thailand will one day have no more trade deficit due to the import of information technology. Radio, television, telephone, and computer technology are indispensable in living our life; they have become the fifth basic necessities. Nontheless, the country needs a serious long-term planning taking the cases of other Asian countries as examples. Korea, Taiwan, Hong Kong, and Singapore have been called the "NICS", and why not Thailand in the near future? Human resources must be upgraded because it is the mind, spirit, and brain that control, lead, and manage the nation. In the long run, the government has to revise and set up new national education policies. As for the problems facing the country now, new measures regarding the import of information technology should be urgently implemented so that while importing, the country's infrastructure be fully utilized, local people simultaneously trained, and research and development allocated more fund and attention.

Footnotes

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NEW ZEALAND: NEW REGULATORY DIRECTIONS

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1. ABSTRACT

Since 1987, New Zealand has progressively introduced major regulatory changes to the telecommunications and broadcasting sectors, with the objective of promoting increased competition and efficiency in the provision of these services. These changes are being accompanied by changes in the management of the radio frequency spectrum, to ensure more efficient allocation of this essential resource and to meet expected increases in demand for spectrum arising from the liberalisation of broadcasting and telecommunications. Although the establishment of this new regulatory environment has only recently taken place, and some aspects (particularly in the area of spectrum management) are still being implemented, benefits to the consumer, users and to the industries concerned are already apparent.

2. TELECOMMUNICATIONS

The telecommunications sector has been subject to progressive and extensive liberalisation, culminating on 1 April 1989 with the passing of the Telecommunications Amendment Act 1988. This Act abolished the statutory monopoly formerly held by the Telecom Corporation of New Zealand (a state owned company) on the provision of public switched network services, thus permitting competition in the provision of all telecommunications services.

The main features of the new telecommunications regulatory regime are:

- there are no industry-specific regulations or regulatory body. General competition law (the Commerce Act) provides the primary means of ensuring fair competition between operators
- there are no restrictions on the activities or numbers of entrants to the market, or licensing requirements for operators (except for the need for a radio frequency licence, where appropriate)
- however, special regulations (the Telecommunications (International Services) Regulations 1989) apply to operators providing facilities-based international services. The intent of these Regulations is not to restrict market entry, but to ensure that overseas operators with monopoly privileges in their own markets do not engage in market distorting behaviour in New Zealand
- there are no restrictions on foreign ownership, other than those applying under general law pertaining to foreign investment (the Overseas Investment Act).

The removal of the Telecom monopoly marked the last stage of a progressive programme of deregulation. This programme is consistent with general government economic policy which is characterised by:

- the reduction as far as possible of direct government intervention in commercial activity
- the establishment of a regulatory environment which facilitates fair and open competition for the benefit of the consumer
- "competitive neutrality" for state-owned enterprises (ie state-owned enterprises are required to compete on an equal basis with private organisations)
- the separation of policy and regulatory functions from purely commercial activities, so that managers of commercial enterprises have clear, unconflicting objectives.

The lead up to full deregulation included:

1 April 1987: the New Zealand Post Office (a government department with both commercial and regulatory responsibilities) was restructured into three separate state owned corporations (Telecom Corporation of New Zealand Ltd, providing telecommunications services; Postbank Ltd, providing personal banking services; and New Zealand Post Ltd, providing postal services). Regulatory and policy functions exercised by the former New Zealand Post Office were transferred to the Ministry of Commerce, leaving the corporations free to operate on a fully commercial basis.

1 October 1987: progressive deregulation of the market for customer premises equipment was introduced. This process began with residential wiring and telexes, followed by telephones on 1 May 1988, and PABX on 1 April 1989.

July-November 1987: the Government commissioned a study on the potential for competition in telecommunications network services. The study, carried out by UK consultants Touche Ross and Co, concluded that the introduction of competition in telecommunications network services would result in:

- increased efficiency and responsiveness to customers' needs on the part of Telecom
- tariff rebalancing by Telecom to align prices more closely to costs
- faster uptake of new technology
- entry by competitors primarily into niche markets, particularly focussing on the provision of long distance and business services. Because of the size of the market, only one main (ie network-based) competitor was anticipated.

17 December 1987: the Government announced its decision to open the network services to competition.

1 April 1989: implementation of full telecommunictions deregulation.

At the time of writing (November 1989), no major competition to Telecom in the provision of public switched network services has as yet occurred. This is not unexpected: overseas experience indicates that it can take some time for significant competition to emerge. In the meantime, however, alternative private line and private network facilities have become available to business users via AUSSAT, for communications both within New Zealand and trans-Tasman, and a number of other companies are also providing private line and private network services. There have also been strong indications of interest in establishing public switched network services from a number of sources, both overseas and within New Zealand.

Of more immediate significance is the effect which the prospect of competition has had on Telecom. This has been reflected both in the increased efficiency of the Corporation itself, and in improved prices and service to the customer. Key features have included:

- restructuring of Telecom into a number of subsidiary companies. These are required to operate as separate profit centres and to deal with one another on an "arms-length" basis
- the preparation by Telecom of transparent terms and conditions for interconnection in full consultation with interested parties
- a reduction in toll charges by around 50 percent since mid 1986. While there has been some increse in line rental charges, these have for the most part simply kept pace with inflation. The net result is an estimated reduction in the average consumer's telephone bill of some 20 percent in real terms over the past three years. Similarly, business users have benefitted from reduced charges for private lines
- improved quality of service, particularly in reduced waiting times for installation and connection. The average time for telephone connections is now 72 hours, compared with several months in some cases, prior to corporatisation.

Direct benefits to the consumer have also resulted from the deregulation of customer premises equipment. The number of equipment suppliers has increased rapidly, providing customers with real choice. At the same time, there has been a marked fall in prices. For example, a basic model telephone now costs approximately half its early 1988 price, while car phones have reduced from around NZ$3000 in mid 1988 to NZ$500 in 1989.

3. BROADCASTING

In 1988 the Government announced its intention to introduce more competition into broadcasting, while maintaining a commitment to meet defined social objectives and to ensure that standards of good taste and decency continued to be met. This decision was taken following reviews undertaken of broadcasting policy in general, and of options for the restructuring of the Broadcasting Corporation of New Zealand (the state broadcaster, which at that time held a monopoly on television broadcasting) to reflect policy relating to the operation of state-owned enterprises.

New legislation giving effect to these decisions entered into force on 1 July 1989. The key elements of the new broadcasting regime include:

Restructuring of the Broadcasting Corporation (BCNZ): the BCNZ has been restructured into two state owned companies, Radio New Zealand and Television New Zealand. (The process of restructuring was implemented under the Broadcasting Amendment (No 2) Act, which came into force on 1 December 1988). These companies are expected to operate commercially in response to increased competition made possible by changes in broadcasting policy. Provision has however been made to ensure the Government's social objectives are met. The shift to a more commercial orientation, and revised organisational structures has been welcomed by executives of the new companies.

Reduction of barriers to entry: the former complex warrants system for broadcasters, which resulted in extensive delays and administrative costs has been abolished. As a result there are no restrictions on entry to the broadcasting market, provided appropriate radio frequencies can be obtained. (Policy concerning the allocation of the radio frequency spectrum is outlined in a later section of this paper).

In addition, more flexible provisions on foreign and cross media ownership have been introduced. The maximum level of foreign ownership in respect of radio and television broadcasting firms is fixed at 15 percent, although this may be increased to 25 percent for radio broadcasting firms with the approval of the Minister of Broadcasting.

Social Objectives for Broadcasting: a grants scheme administered by a Broadcsting Commission has been established to encourage the production and broadcasting of programmes to meet the Government's defined social objectives. These objectives include:

- to reflect and develop New Zealand identity and culture

- to maintain (and where justified in social terms to extend) coverage of radio and television broadcasting to remote New Zealand communities

- to ensure that minority interests are catered for. In this regard, particular provision is made for Maori broadcasting, for which a minimum of 6 percent of Broadcasting Commission funding has been allocated.

In addition to the grants scheme, the Government has retained ownership of two television channels and two radio networks. These are required as a matter of government policy to reflect New Zealand identity and culture, and to encourage New Zealand-made programmes. These requirements are included in the state broadcasters' Statements of Corporate Intent.

The decision to rely on a grants scheme (rather than some form of quota system) was taken for the following reasons:

- administrative simplicity, thus reducing costs both to the Government, and to broadcasters

- assistance can be readily targetted to more particular forms of programming which most readily meet social objectives. Quota systems have an inherent weakness in that, to ensure particular programme requirements are met, complex points systems must be developed

- costs and benefits are readily identifiable

The grants scheme is funded by the Public Broadcasting Fee. It is anticipated that net funds of around NZ$75 million will be available to the Broadcasting Commission for the year ending 30 June 1990.

Standards: a Broadcasting Standards Authority has been established to ensure that programming continues to have regard to the general principles of:

- standards of good taste and decency

- maintonance of law and order

- the privacy of the individual

- balanced presentation of controversial issues of public importance

The Authority's role is to encourage broadcasters to develop and observe codes of industry practice, in consultation with community interest groups. These codes are to cover standards for the protection of children; portrayal of violence; fair and accurate programming; restrictions on the promotion of liquor; avoidance of the denegration of persons or sections of the community on the grounds of race, sex, age, occupational status or religion. Where codes do not meet the Authority's approval, it is bound to develop these itself.

The Authority also determines complaints against broadcasters and where standards are contravened, has wide-ranging powers to impose penalties, including the right to order a broadcaster to cease broadcasting for a period of 24 hours. There are appeal rights to the High Court against the Authority's decisions.

In addition, contracts for radio spectrum for radio or television broadcasting will include a provision that the contract is voidable in the event of failure to comply with a determination by the Authority.

Advertising: more liberal advertising hours have been permitted. Restrictions now apply only to Christmas Day, Good Friday and Easter Sunday, and in the case of television, to Sunday mornings. The intent of this change is to increase broadcsters' ability to raise revenue. This should in turn enable Broadcasting Commission funding to achieve maximum benefit, ie by "topping up" funding for less commercially attractive, but socially desirable programmes.

3. RADIO FREQUENCY MANAGEMENT

Increased competition in telecommunications and broadcasting can be expected to lead to increased demand for spectrum, and scarcity in some frequencies. This will require choices to be made between competing uses and users, a function which the present allocation system (centrally administered by the Radio Frequency Service of the Ministry of Commerce, primarily on a first-come, first-served basis) is not well placed to implement.

A study commissioned by the Government from UK consultants National Economic Research Associates (NERA) in late 1988 recommended a market based system, with tradeable management rights to be tendered where there was sufficient demand and where this was compatible with New Zealand's international obligations.

Legislation giving effect to the Government's decisions on spectrum management (the Radiocommunications Bill) was introduced into Parliament in July 1989. This reflects, with some modification, the recommendations of the NERA study, and is expected to enter into effect in December 1989. The main elements of the proposed system are:

Management Rights: a legal definition of management rights to spectrum use within defined engineering parameters has been created. These rights are accorded certain attributes of property, including the right of transfer, aggregation or division, and use as financial security. Rights will normally be for a period of 20 years, in order to encourage investment to make use of them.

Tendering System: where there are competing demands for spectrum (and where this is compatible with international obligations), allocation of management rights will be made on the basis of a sealed bid (second price) auction. This is to ensure that tenders are based on the true economic worth of the spectrum. The first stage in this process will be a call for expressions of interest from potential users, to determine the nature of requirements/proposed uses of spectrum. This will enable the "design" of the most appropriate spectrum packages for tendering.

Tradeability: rights are fully tradeable. A central public registry recording details of transactions and usage will be maintained by the Radio Frequency Service of the Ministry of Commerce.

Provisions for Existing Users: existing users of spectrum will be given preferential treatment to avoid any unnecessary disruption to ongoing services. These provisions vary between services, depending upon the existing form of spectrum access and commercial demand likely. A comparable 20 year right, of an appropriate type, will be generally available to existing users, subject to payment of a levy based on a percentage of gross income. Options for progressive yearly payments or capitalisation are proposed. A number of specific conditions of licence are also planned to ensure continuance of certain existing social and community programs and services.

Competition Safeguards: general competition law (the Commerce Act) will provide the primary safeguards against anti-competitive behaviour in respect of spectrum acquisition. The Radiocommunications Bill provides for controls under the Commerce Act over the acquisition of spectrum and subsequent spectrum transfers, where such transactions would result in dominance in any individual service market in telecommunictions or broadcasting. The Commerce Act can also be invoked should anti-competitive hoarding occur.

Residual Management: management of certain frequency bands by the Ministry of Commerce will continue in the following cases: frequencies below 44 Mhz which can cause long distance interference (except AM broadcasting frequencies, which are internationally allocated); frequencies above 3.6 Ghz, if there is no significant demand; frequencies for short-term broadcasting uses.

Transitional Arrangements: full transition to the new regime is expected to take several years. An indicative timetable has been established for bringing frequencies under the registration system, with priority accorded to new services with major commercial significance. Expressions of interest have already been sought for UHF bands primarily for television and for cellular radio frequencies. However, the implementation will necessarily be governed by resources available and requirements for spectrum resulting from deregulated downstream markets.

Ministry of Commerce
Wellington
November 1989

Session 2.3

Regional Communications in a Global Setting

NOTES

THE PACIFIC TELECOMMUNICATIONS COMMUNITY: PROBLEMS AND PROMISE

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Abstract

Telecommunications standards are necessary, but not sufficient, for enabling full digital connectivity in the Pacific Rim Region. National policies and plans also have an impact on the choices made during implementation. These choices, based on different policies and plans, may lead to significant incompatibilities in networks, terminals, and services, thus slowing telecommunications progress. This is already apparent in the implementation of narrowband ISDN. Telecommunications progress and widespread participation in the benefits of telecommunications growth depend upon creating an open and compatible telecommunications infrastructure. A way must be found to accommodate the various national policies and encourage participation by all nations of the Region. The authors propose a forum to coordinate implementation of telecommunications standards, in order to achieve an open Pacific Rim telecommunications infrastructure.

1. Introduction

A recent report by the National Telecommunications and Information Administration (NTIA) presents a challenge for the 1990s to nations around the world:

> Spurred by competition, less fettered by unnecessary regulatory burdens, and encouraged by Government, science and industry can create, develop, and distribute a wealth of telecommunications and information devices, processes, and networks that will dramatically enrich our society by the year 2000. The timing, extent, and cost of these enrichments will depend not only on creative and productive efforts, however, but also on the wisdom and forbearance of government policymakers and regulators, both in the United States and throughout the world.[1]

This challenge is particularly applicable to the Pacific Rim. In view of current trends, the 1990s may emerge as the telecommunications era of the Pacific Region. New research directions on such topics as teleworking, telemedicine[2], and distance education[3] indicate that distance and isolation no longer need impede social and economic development. Thus, encouraged by the possibility of wider participation in economic development through telecommunications, numerous countries throughout the Pacific Rim Region are actively investing in their telecommunications futures.

In a previous paper[4], the authors explored the concept of a Pacific Rim Telecommunications Community. The Pacific Rim Region was defined literally as including those nations which border the Pacific Ocean. This definition, which is also the basis of this paper, includes such countries as the USSR, Chile, Nicaragua, Japan, and Australia. Despite the Region's enormous diversity, standards development provides a vehicle for international cooperation and harmonization, leading toward a greater sense of Community among Pacific Rim nations.

Technological standards are not sufficient to create a true Pacific Region Telecommunications Community, however. A community regards issues and problems from a shared and multinational perspective, and hence distributes the benefits from the telecommunications revolution to the greatest number of Community members. To create a community, therefore, individual national telecommunications implementations must lead to an integrated Pacific Region telecommunications infrastructure. Telecommunications standards create communality in principle, whereas individual national policy and plans determine the equally critical choices made at implementation. These individual national choices may lead to significant incompatibilities in networks, terminals, and services, thus slowing down telecommunications progress.

Currently, very little coordination takes place among Pacific Rim nations in the implementation of such technologies as ISDN. Implementation agreements are primarily brought about through bilateral negotiations between vendors and telecommunications providers representing the most developed nations. This lack of wider input has two undesirable effects. First, little attention is given to developing an integrated region-wide infrastructure. Second, less technologically developed nations have little opportunity to participate in such negotiations and consequently develop their own policies and plans in isolation.

Using the experience gained with an international ISDN trial, this paper will illustrate such potential incompatibilities with ISDN. U.S. and European telecommunications policy models are also explored to define an organization which will help create a Pacific Rim Telecommunications Community. It will discuss sources of ISDN incompatibilities and provide several examples. It will also illustrate the diversity of the Pacific Rim Region in terms of its geography, culture, trade, and telecommunications development and offer a proposal for a forum that could help achieve harmonization of plans and policies. By creating common ISDN implementation patterns, this organization could also help establish a true Pacific Telecommunications Community.

2. Beyond The Blue Book Standards: Policies, Plans & Implementation

The telecommunications standards efforts of the last decade have been successful in creating international agreement on a range of telecommunications technologies. In November 1988 the CCITT Plenary accepted the so-called Blue Book recommendations for ISDN that had been prepared during the preceding four-year study period. Many countries, already well into ISDN tests and trials, saw this as the starting gun for commercial ISDN. Recent experience with an international ISDN test between California and Japan, however, has proven that the standards do not prevent significant incompatibilities in the protocols and services supported by one or more links in the network. Figure 1 illustrates the multiple interfaces where incompatibilities can occur.

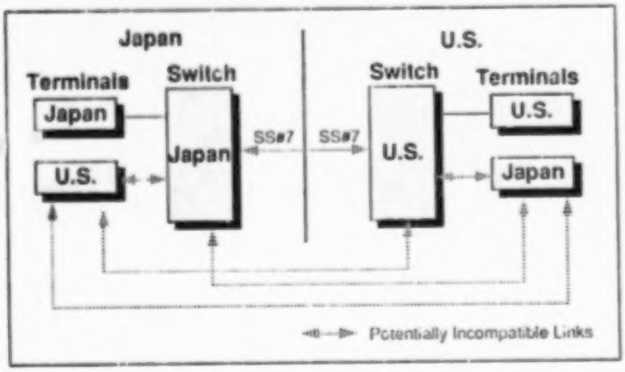

Figure 1. Incompatibilities in End-To-End ISDN Network

There are four predominant causes of incompatibility when policies, plans, and implementation are not coordinated:

1. **Multiple Standards.** V.110 and V.120 rate adaptation protocols both allow slower speed data on a 64 kbps B channel, but they are incompatible. Terminals at each end of the connection must use the same rate adaptation protocol in order to communicate.

2. **Incomplete Standards.** The Supplementary Services section in the 1988 CCITT Blue Book does not specify signaling protocols on the D channel. Most networks will offer a much richer menu of services which will likely be implemented in proprietary fashion.

3. **Ambiguous Standards.** In CCITT Recommendation Q.931, when synchronization is lost between the terminal and the switch, the switch issues a Status Enquiry message. The terminal response, however, is not clearly specified. Some terminal designs will not respond to this loss of synchronization message. The switch may subsequently take the terminal out of service.

4. **Selection of Options.** Options selected in one network can impact the end-users served by another network. An example is the manner in which terminal selection takes place on a passive bus during call setup. Some networks perform terminal selection using subaddress information, while other networks don't. Therefore, users on one network may need to find alternate methods to address a specific terminal on the passive bus of another network.

In addition to standards, aspects of policies, plans, and implementation lead to incompatibilities:

Regulatory Policies. Regulatory constraints vary significantly among Pacific Rim nations. In the U.S., for example, Regional Bell Operating Companies (RBOC) are generally prohibited from providing Information Services. In countries such as Japan, telephone companies are encouraged to provide such services. Thus, different regulatory environments will lead to incompatible services among nations.

Differences in Implementation Timeframes. Japan is offering the Basic Rate Interface (BRI - 64 kb/s), Primary Rate Interface (PRI - 1.544 Mb/s), and N x 64 kbps (variable rate) ISDN transport this year. U.S. companies, although technically capable of supporting the variable rate service may not offer it for at least another two years. Thus only standard BRI and PRI transport can be offered across the Pacific in the near future. This limitation will delay any services, such as video conferencing, which depend on variable data rates above 64 kbps.

These sources of incompatibility become particularly important when we recognize that the customer today expects ISDN to offer **universal compatibility** and **advanced services**.[5] Such expectations cannot be met by standards alone, but depend as well on cooperation among nations during implementation.

3. Pacific Rim Region

How difficult will it be to reach agreement on complex telecommunications issues among the many nations of the Pacific? To answer, one must understand the diversity of telecommunications infrastructure and focus. The Pacific Rim Region, now home to well over 40 percent of the world's population, will soon contain 6 of the 10 largest urban centers in the world. The estimated economic growth rate of the Region far exceeds that of the rest of the world[6] (see figure 2).

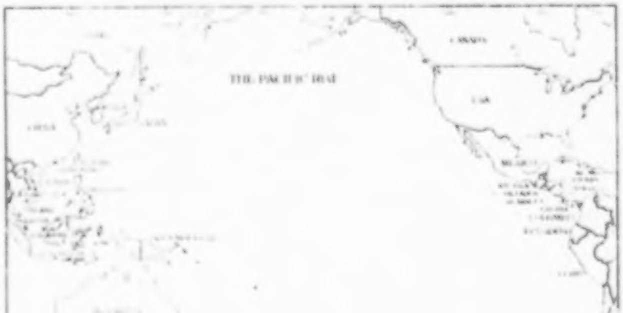

Figure 2. The Pacific Rim Region

Over 30 nations and 10,000 islands covering 64 million square miles (166 square kilometers), a full one-third of the earth's surface, rim the Pacific Ocean. Many of these nations are separated by bodies of water so vast as to have posed serious obstacles even for the migration of animal life after the last glacial period.

The Pacific Rim geography is no less a function of perception than of space. The U.S. emphasis in terms of trade is not on our close neighbors in Mexico and Central America, but on Japan, Korea, and Taiwan. In fact, a popular image of the Pacific Rim Region usually includes Asia but excludes the Western shores of Central and South America. Mexico and Canada are also not often viewed as Pacific Rim nations. Although such perceptions may have an historical basis, they place the U.S. at a significant disadvantage by restricting our interaction with nearby potential partners.[7] As we move into the 1990s, it will become more apparent that the prosperity and development of each individual nation affects all others.

3.1. Pacific Rim Region Telecommunications Development

The Pacific Region presents a varied quilt of telecommunications development. Individual nations differ significantly in telecommunications penetration (number of telephone sets per capita), services offered, costs, and flexibility. The great economic diversity of the nations in the Pacific Rim Region leads to a similar diversity in their telecommunications needs and policies.

Thus, Pacific nations present a wide range of national telecommunications profiles which can be broadly categorized as follows[8]:

1. **Competition.** National and international competitiveness is strengthened through privatization and the application of advanced technologies. An example is Japan, with a policy of increasing competitiveness and diversification in the telecommunications market. Similarly, in its rapid deployment of ISDN, Singapore shows that it views modern telecommunications technology as a key to its competitiveness. (Some of the more aggressive implementing nations are discussed by J. Williamson.[9])

2. **Monopoly.** A single organization is in control of national telecommunications. Australia is an example of a Pacific Rim nation which manages all its telecommunications infrastructure within a single organization. This structure is very advantageous from the standpoint of coordinating implementation at a national level. It also facilitates a focused national telecommunications policy. However, it can impede progress in a less developed nation.[10]

3. **Universal Service.** Telephone services are proliferating throughout the economy. For example, Korea's telecommunications capabilities have shown tremendous growth during the 1980s. The number of phones per 100 inhabitants grew from 9.0 in 1980 to 21.8 in 1986. This rapid development is based on the belief that "the telephone system contributes directly to economic development..."[11]

4. **Development.** Basic telephone service is brought to technologically underdeveloped regions. Many of the islands of the Pacific and Latin American countries understand the importance of bringing modern telecommunications capabilities to their countries. Political, economic, and cultural concerns often slow this progress. Rural telecommunications development is the highest planning priority.[12]

Each of these profiles results from the intersection of internal economic development and external market opportunities. They illustrate the diverse needs and points of view that must be brought into alignment to achieve an integrated Pacific Rim Telecommunications Community.

4. Towards a Pacific Telecommunications Community: Harmonization

In previous sections, we have described the major areas of discrepancy in telecommunications development in the Pacific Rim--discrepancies that standardization alone will not remove. How, then, can we achieve the harmonization of national plans and policies, and the coordination of implementation so that progress can take place not separately in each isolated country, but in harmony? We will briefly review possible models for an organization or forum that could help in this effort.

4.1. European Model

The European model is a European Community (EC) pseudo-governmental body which sets policy and implementation guidelines for all member countries. The objective of the EC is to create, within Europe, a single unified market which will help return Europe to its former world-class competitor status. It attempts to achieve that unification by superimposing on local governments an international government with far-reaching powers. One of the most significant EC contributions is the 1987 Green Paper, a draft policy statement on the development of a common market for telecommunications services and equipment. Although lacking in detail, the paper provides a rallying point for future telecommunications development within Europe. Furthermore, the EC is also becoming an important source of mandatory pan-European telecommunications standards. These standards effectively supercede the wide variety of national standards.

The development of European telecommunication standards over the past ten years provides an excellent example of effective international cooperation. Despite some cultural and economic differences among European nations, Europe has been able to make significant progress towards a unified telecommunications position. It is doubtful that a pseudo-governmental body of this kind would be viable in the Pacific Region, however. Although there are numerous economic and political alliances, such as the Four Tigers and the Association of Southeast Asian Nations (ASEAN) nations, the great diversity and independence among Pacific Rim countries makes this pseudo-governmental body an unlikely model.

4.2. The U.S. Model

The U.S. presents a more appropriate policy model for the Pacific Region than one might expect. The first reason is that there is no single U.S. policy on telecommunications. Instead, there is a patchwork quilt of at least twelve major organizations, often providing conflicting policies. This is based on a cultural distrust of monopolies and a confidence in the benefits of competition. The second reason the U.S. model seems appropriate is that the post-divestiture U.S. telecommunications industry is a complex mixture of local and long distance service providers, manufacturers, regulators, and research organizations.

These two facets of the American telecommunications

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environment are reminiscent of diversity of telecommunications policy and plans in the Pacific Rim Region. How can island ISDNs evolve into an integrated end-to-end ISDN under such circumstances? One key solution to this problem in the U.S. is the role of Bellcore, a jointly funded research organization. Bellcore defines equipment specifications and requirements which go beyond the high-level interface specifications of the national standards.

Another key solution to harmonizing ISDN implementation is the recently established NIU (North American ISDN Users) Forum, sponsored by the National Institute of Standards and Technology (NIST). This voluntary organization brings Application Requirements developed in the NIU Users' Workshop and submits them to the Implementors' Workshop for discussion and the development of Implementation Agreements and Application Profiles. The result is that users and implementors are forced to confront the practical problems in implementing ISDN.

Given the nature of the U.S. telecommunications environment and the integration role of Bellcore, the U.S. model for dealing with ISDN implementation under complex circumstances is more appropriate for the Pacific Rim than the pseudo-governmental European model.

4.3. The Pacific Telecommunications Forum: A Proposal

Some work on policy harmonization has started. For example, the South Pacific Telecommunication Development Program (SPTDP) established by the South Pacific Forum (SPF) represents a focused effort to increase the penetration of telephone services in five Pacific island nations.[13] However, this type of organization focuses on funding rather than implementation.

The NIU Forum format used in the U.S. has several features that make it an excellent model for the Pacific Rim. Entirely voluntary and non-political, it focuses on applications and the practical solutions they require, brings together diverse users' and implementors' groups, and erects no barriers to participation. It is also sponsored by another organization, thereby relieving it of burdensome administrative requirements. The authors, therefore, propose the establishment of a Pacific Telecommunications Forum (PTF). Such a Forum would create Pacific Rim ISDN implementation agreements which rest on the realities and requirements of the Region.

4.3.1. PTF: Objectives and Attributes

The PTF would have two main objectives: the development and harmonization of ISDN applications and the coordination of national and regional plans and implementation. Designed to be consultative rather than directive, it would provide valuable input and commentary for participating nations. It would do so by coordinating and integrating the implementation of ISDN based on existing telecommunications standards. It would primarily provide implementation recommendations and serve to facilitate bilateral negotiations. The attributes of the Forum would:

- Encourage equal representation from each of the countries in the region. Representation could also be accomplished through existing regional associations, such as the SPF or ASEAN. Given the number of nations in the Region, the latter is preferable;

- Define specific and focused goals and a short timeline for reaching those goals (1 - 2 years). This attribute results from the nature of organizations which tend to become self-perpetuating and unfocused. There are far too many existing organizations to warrant the proposal of another if it is not focused and temporary;

- Sponsor meetings held throughout the Region so all nations have equal access to participate in the Forum;

- Provide output such as a report detailing preferred ISDN implementation choices in the Pacific Rim Region.

4.3.2. Sponsoring Organizations

In proposing a Forum for service compatibility in the Pacific Rim Region, a sponsoring organization must be found. The PTF is not intended as a permanent organization, nor is it the authors' intent that the PTF be administratively complex. Instead, it is envisioned as a temporarily chartered sub-group of an existing sponsoring organization. This sponsoring organization will organize the Forum and disseminate its conclusions.

Many different organizations which focus on some aspect of the Pacific Region have been formed in recent years.[14] The majority focus on economic issues and tend to exclude countries such as Chile, Mexico, and the USSR. Other international organizations focus on telecommunications, but not specifically on the Pacific Rim Region as defined in this paper.

The only organization with a single focus on Pacific Rim telecommunications is the Pacific Telecommunications Council (PTC), composed of individuals and both profit and non-profit corporations and other organizations. The goal of this non-profit organization is to promote the development, understanding, and beneficial use of telecommunications throughout the Region. The PTC is a forum for exchanging ideas and its focus has been largely educational.

The International Communications Association (ICA) is a similar non-profit organization with individual and corporate members who are users, not suppliers, of telecommunications services and equipment. Its purpose is to exchange information and experiences, and promote, support, and encourage the maintenance and development of member telecommunications infrastructure and capabilities. The ICA does have a standing committee focusing on public policy; however, its focus is neither regional nor service-oriented.

The International Telecommunications Union (ITU), on the other hand, is an organization of member countries. Chartered by the United Nations, its purpose is to maintain and extend international cooperation for the improvement of telecommunications of all kinds and to harmonize the actions of nations. The ITU can sponsor both regional administrative conferences, and provide technical assistance to various regions.

The Institute of Electrical and Electronics Engineers (IEEE) has a Communications Society (COMSOC) which focuses of the technical aspects of communications. The IEEE also develops international standards for telecommunications and other electronic industries. COMSOC is allowed to charter committees to focus on particular aspects of communications and to organize technical sessions for the IEEE's two annual international conferences. Membership is for individuals only.

A summary of potential sponsoring organizations and their attributes is shown in Figure 3.

Attributes	Organizations				
	Potential Sponsors				Proposed
	PTC	ICA	ITU	IEEE	PTF
Membership	Individual or Corporate	Individual or Corporate	National	Individual	National or sub-Regional
Structure	Non-Profit Corporation	Non-Profit Corporation	International Government	Non-Profit Corporation	Temporary Sub-Group
Sponsor	N/A	N/A	United Nations	Recognized by ANSI*	PTC or ITU
Focus	Pacific Telecom	Telecom Users	International Telecom Harmonization	International Elec. Engn. Prof. Assoc.	Regional Compatibility for ISDN

*American National Standards Institute

Figure 3. A comparison of Organizational Attributes.

Of the potential sponsoring organizations studied, the PTC or the ITU are viewed as the most appropriate: the ITU, because the proposed work appears to be completely within its charter; and the PTC, because it is probably in the best position to quickly organize and focus on such a Forum.

5. Conclusion

The standards for much of ISDN were formally accepted during the CCITT Plenary session held in Melbourne, in November 1988. The results will be published in the so-called Blue Book series. This historical event marks the beginning of an even more demanding task: worldwide implementation with the greatest degree of compatibility possible--global universal digital service. European nations have made significant progress toward a standard implementation by their steady march towards a unified Europe. The U.S. has made progress through Bellcore, several industry associations, and the NIU.

The Pacific Rim Region does not currently have in place a working body for harmonizing ISDN implementation. This paper recognizes the diversity of the Region, and in particular of its telecommunications development. We argue for the creation of a Pacific Rim Region Forum which promotes the harmonization of telecommunications policies and plans. A Pacific Telecommunications Forum is hereby proposed with the very specific regional goal of harmonizing plans and implementations for narrowband ISDN. Given the large number of existing organizations, we do not propose another. Instead, we propose that the PTF be formed under the umbrella of an existing sponsoring organization. Furthermore, we propose that the PTF be a temporary sub-group of such a sponsoring organization, and that its work be focused on Regional compatibility of narrowband ISDN plans and implementation. This format will make possible an open telecommunications infrastructure that can accommodate the varied circumstances and needs of individual nations, and thus result in a more cohesive Pacific Telecommunications Community. Regional harmony will contribute to global harmony of plans and implementation for ISDN.

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GLOBAL NETWORKS IN TRANSITION -- THE EUROPEAN FACTOR

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1. ABSTRACT

This paper explores the telecommunications regulatory scene in Europe and draws attention to Europe's global influence. The nature and scope of the radical changes now taking place within the European Community are then discussed within the context of the drive towards the Single Market in 1992. After discussing common elements of the telecommunications envirnonments in Europe and the Pacific, the paper concludes with observations concerning the mutual benefits to be gained by closer ties between the two regions.

2. BACKGROUND TO EUROPEAN TELECOMMUNICATIONS

2.1 THE EUROPEAN "PTTS" AND THEIR INFLUENCE IN EUROPE

The origins of the policies which have fashioned the European telecommunications environment can be traced to the strong individual monopolies of the European Post, Telegraph and Telephone Authorities (PTTs). France holds the distinction of being the first in the field to make telegraphy into a state monopoly in 1874.

The conveniently short term "PTT" which is still commonly used when referring to any telecommunications authority is rather too sweeping today. For in a number of countries the Post and Telecommunications responsibilities are now separated. The Telecommunications Authorities or "TAs", as they will be referred to from now on, also differ considerably in structure and ownership. Finally the responsibilities and future role of these bodies is changing in Europe as governments re-examine their approach to telecommunication regulation.

A substantial proportion of the criticism the European TAs have faced in the past should more properly have been directed at the policies of the national governments of which many of them form a part. However, there is a widely held view, that even taking this into account the TA decisions and performance in connection with new services has been generally poor. Also there has been an apparent preoccupation with monopoly protection and a lack of sensitivity to user needs.

The influence of the supply side of the telecommunications industry in Europe is at present far stronger than that of the business and user communities. The TAs in particular combine a highly developed sense of territory with resolute and expert political defence. As government departments many of them also have easy access to policy makers at both the national and European level and as very large employees of skilled labor they are ably supported by powerful trade unions. There is therefore an ever present danger in Europe that undue weight will be given to narrow considerations concerned with the telecommunications industry itself, thus obscuring the wider business and economic needs.

2.2 THE GLOBAL INFLUENCE OF THE EUROPEAN ADMINISTRATIONS

Among the many outstanding achievements in the history of telecommunications, the formation in 1865 of what was to become the International Telecommunications Union (ITU) tends to be overshadowed. However, the vision required to foresee the need for international cooperation so early — over 10 years before the telephone was invented — was extraordinary.

Europe can point with some pride to its part in the formation of the ITU which originated in an International Telegraph Conference held in Paris in 1865. The following countries, all European, were represented: Austria, Baden, Bavaria, Belgium, Denmark, France, Greece, Hamburg, Hanover, Italy, the Netherlands, Norway, Portugal, Prussia, Russia, Saxony, Spain, Sweden, Switzerland, Turkey and Wurtenburg. Those familiar with the European telecommunications scene of today may find a certain irony in the fact that Great Britain was excluded because its telegraph services were in the hands of private companies. They will also note that the prominent role of France in European telecommunications has deep and ancient roots.

Today the Telecommunications Administrations wield by far the greatest influence at the CCITT (International Telephone and Telegraph Consultative Committee of the ITU) and the 26 European Administrations who are members of the CEPT (Conference of European Post and Telecommunications Administrations) represent an extremely powerful lobby. Because most of the important work of the CCITT takes place in Geneva, many of the European TAs are able to attend the meetings. The CCITT operates as a rule on a consensus basis and this also acts in the CEPT's favor. On important subjects the CEPT members can and do negotiate their positions beforehand and speak separately in support of one another to great effect. This tactic is particularly noticeable in the discussions on tariff principles.

The European PTTs are, quite rightly, advocates of international cooperation and a CCITT recommendation is, as a rule, adopted in all European countries. The influence of the CEPT within the CCITT therefore reflects back into the European telecommunications market. However it will also be seen that the CEPT's influence on telecommunications is felt throughout the world. While there are positive aspects to this, the scope for mis-using the collective power of the European TAs is also evident. Many of the genuine concerns felt both in Europe and beyond regarding the influence of the CEPT would be relieved considerably if this important body would only adopt a more open policy.

2.3 1992 AND THE SINGLE EUROPEAN ACT

2.3.1 1992-AN OVERVIEW

The Single European Act (SEA) stems from two complementary initiatives aimed at furthering progress towards economic and political unity within the EEC. In 1984 the European Parliament adopted a "draft treaty establishing the European union" which was followed by a "white paper on completion of the internal market" produced by the Commission of the European Communities (the CEC) in 1985.

The Single Act, as the SEA is more usually termed, came into effect in July, 1987. It is so called because the one document contains a number of measures to facilitate completion of the internal market by the end of 1992. Its purpose is encapsulated in the following brief extract from the preamble to the SEA which stipulates that the Member States will *". . . transform relations as a whole among the States into a European Union"*.

The common goal of 1992 (or more accurately 1 January 1993) has provided the spur which the Community needed and approximately 180 proposals are currently directly connected with the White Paper.

2.3.2 TELECOMMUNICATIONS AND THE SINGLE MARKET-THE GREEN PAPER

In June, 1987, the CEC issued a "*Green Paper on the development of the common market for telecommunications services and equipment*" which marks a turning point for European telecommunications. The reasons for this CEC initiative were as follows:

- to remove telecommunications barriers between the Member States by 1992;
- to foster the development of the telecommunications and information industries within Europe;
- to avoid numerous, complex individual legal cases under the anti-trust legislation of the Community (the EEC Treaty competition rules).

The main thrust of the Green Paper is the injection of competition into a sector characterized by strong and rigid monopoly. As Vice-President Narjes of the CEC said in February, 1988:

> *"(t)he Green Paper is based on the fundamental principle that in the interests of the European economy, full use has to be made of development in technology and in the marketplace and that for this there is no alternative but more competition."*

The measures arising from the Green Paper (see attachment) have stirred up a substantial controversy which is reaching a peak as this paper is being finalized. The prospects for implementation of the Green Paper proposals would be poor if entirely dependent on a consensus among the 12 Member States. Certainly there would be little chance of the more liberal proposals surviving if they had to run the gauntlet of the cooperation procedure which measures aimed at the Single Market normally follow. Fortunately, this procedure (and to some extent the political consensus) does not appear to be essential to the creation of a more liberal telecommunications environment in Europe. The Commission is invoking the competition rules of the EEC Treaty in order to implement the more controversial aspects of its proposals.

2.4 THE COMMUNITY COMPETITION RULES

A number of the Treaty rules of the European Community exist to ensure fair and open competition within the Common Market. It is only in recent years that these rules have become important in a telecommunications context and the reasons for this can be traced to one important case.

The competition rules of the Community apply to commercial undertakings and until 1985 it was uncertain whether European TAs could be included in this category. The "British Telecom" case which is described briefly below removed this doubt and represents a turning point in European telecommunications.

2.4.1 THE "BRITISH TELECOM" CASE

The case arose because of the activities of commercial telex "refiling" agencies in the United Kingdom.

The methods of these agencies varied but the simplest form involved accepting calls from the originators in mainland Europe over the low speed, but high cost telex network, bundling them together, and forwarding them to their destination (notably the U.S.A.) some 50 times faster over the public switchboard telephone network. As the telephone calls from the U.K. were (and still are) often less than the telex calls from the originating countries, the potential for savings and profits will be obvious.

It may be seen from the above that it was not only the telex refilers and their customers who gained financially but also British Telecom (or the Post Office as it then was) through the extra traffic flowing through the U.K. The other European TAs did not approve of this situation and a decision was taken within CEPT that the practice must cease. The Post Office, somewhat reluctantly, duly wrote to the offending agencies and told them to stop the practice. One of the companies "Telespeed," complained to the Commission of the European Communities that the Post Office were in contravention of the Community competition rules.

A Commission decision of December, 1982 condemned British Telecom's action (it became British Telecom in 1981) confirming that the TA had abused its dominant position.

In a curious twist, worthy of comic opera, the Republic of Italy entered the scene and challenged the Commission Decision before the European Court of Justice—while the British Government supported the Commission's decision against the British company!

In March, 1985 the Court found against the Republic of Italy who were ordered to pay the costs. British Telecom was judged to be in violation of Article 86 of the Treaty and the Court confirmed the Commission's view that BT's actions were those of a "commercial undertaking." The Commission had stated that it "regarded the Member States Postal and Telecommunications authorities as commercial undertakings since they supply goods and services for payment."

The "British Telecom Case" and the failure of the Italian appeal in 1985 established beyond doubt that TAs within the European Economic Community are commercial undertakings and therefore (as far as their commercial activities are concerned) are subject to the Community's competition rules.

2.4.2 A CONTROVERSIAL APPLICATION OF THE TREATY RULES

The more important of the CEC's Green Paper proposals can be viewed as a description of the European telecommunications environment as it should exist if the EEC Treaty rules were to be fully applied. This is an argument which the CEC has employed in introducing two important measures for the liberalization of terminals and services. These measures, the CEC maintains, do not represent new regulation but are intended to implement existing Treaty rules.

The CEC's role as guardian of the Community competition rules with regard to public undertakings which are given special rights by Member States such as TAs is spelled out in Article 90 (3) which states:

> *"(t)he Commission shall ensure the appliction of the provisions of the Treaty and shall, where necessary, address appropriate directives or decisions to Member States."*

By addressing directives under Article 90 (3) to the Member States CEC's intention is to prevent the Member States from continuing to grant the special or exclusive rights to their telecommunications Administrations.

The Commission's use of Article 90 (3) in the telecommunications field has proved unpopular with the Member States and the European Parliament because they regard this as an abuse of the CEC powers and a threat to the institutional balance of the Community. France, Belgium, Germany (FRG), Greece and Italy have challenged the CEC in the European Court of Justice regarding a Commission Terminal Directive and a decision is expected in early 1990. The fate of the more important Services Directive (see 3.2) is also dependent on the outcome of this decision.

The Commission cannot issue its own directives unless it is acting in its capacity of guardian of the Treaty rules. Directives aimed at "harmonization" therefore follow the normal consultative route of [Article 100 (a)] which is much slower and where the more liberal telecommunications measures would probably be diluted. It will be seen therefore that both the nature and pace of change in European telecommunications is inextricably linked with the EEC Treaty rules.

3. KEY ASPECTS OF THE CEC'S "GREEN PAPER" PROPOSALS

Space does not permit discussion of all the Green Paper proposals but some of the key aspects are covered below.

3.1 THE TERMINAL DIRECTIVE

A Directive concerned with opening the terminal market to competition was adopted by the Commission in May, 1988. The liberalization of terminal equipment in Europe is already well advanced in most countries and the Directive is of more interest because of the procedure adopted by the Commission as discussed above (See 2.5.2)

3.2 THE SERVICES DIRECTIVE

The CEC's directive on the liberalization of telecommunications services, which is of great importance to the future of European telecommunications, was adopted by the CEC in June 1989 but is not due to be formally issued to Member States until April, 1990. While it has been enthusiastically applauded by the user and business communities, it has been vehemently opposed by some Member States both with regard to its content and to the method [Article 90 (3)] adopted by the Commission.

The reasons for the directive are made clear in the preamble which states:

> *". . . (a) comprehensive approach is necessary in order to end the infringements that persist in certain Member States and to give clear guidelines to those Member States that are reviewing their legislation so as to avoid further infringements. ..."*

The directive does not cover telex, radio-telephony, paging and satellite services. However, there are reasons for this in each case. The exclusion of telex (which is of declining importance in Europe) was a minor concession to the TAs while the other excluded services cannot be covered in a general directive of this kind — special arrangement may be needed for examplefor frequency allocation.

The absence of these areas from the directive does not mean that they are insulated from the Treaty competition rules. They must simply be treated, in the case of disputes, on a case-by-case basis. For example in the unlikely event that any company would wish to offer pure telex in competition with TAs in Europe it would have to take its chances in the courts.

It is perhaps a measure of the directive that it is easier to consider what services will not be open to competition rather than those that will. If it is issued by the Commission in its existing form, all services with the exception of voice telephony will, at some time, be opened up to competition-the only question being when.

Competition in the public packet or circuit-switched data network area has proved to be a controversial topic. There is some ambiguity and apparent confusion in the Directive on the subject but the practical effect is that competition will not be allowed in some Member States before 31 December 1992. Competition, in all countires, should be possible after that date — but possibly subject to stringent licensing conditions.

3.3 OPEN NETWORK PROVISION (ONP)

The success of the CEC's Green Paper proposals is likely to hinge on whether Open Network Provision (ONP) lives up to its name. ONP was originally intended as a mechanism to promote fair competition between vendors of non-reserved services (including the TAs) and to stimulate the growth of such services in Europe. Equally importantly, it was hoped that the existence of such a mechanism would prevent the legal turmoil which could result if numerous individual cases were to be brought before the courts invoking the competition rules.

Equality of access to the network is obviously a central consideration if true competition for non-reserved services is to emerge. Due to the imbalanced process of formulating the ONP rules the user community has expressed a number of concerns that the CEC may be deviating from this path.

Absolute equality of access, though an essential aim, is in some circumstances impracticable and in others may be impossible to achieve. In the U.S.A. the Regional Bell Operating Companies (RBOCs) have been prevented for many years from offering other than basic services for this reason. The chief aim of Open Network Architecture (ONA) in the U.S.A. is to attempt to provide rules which would address this problem of equality of access and so allow the RBOCs to compete for enhanced services.

In circumstances where equality is not possible for any reason it is not an option in Europe to prevent the TAs from competing. However, it may well be possible to prevent abuse arising from any such equality and in this important respect Europe has a useful mechanism in the Community competition rules. It might be unnecessary and uneconomic in Europe to attempt to achieve equality of access in all circumstances.

A "Framework Directive on ONP" is now proceeding through the cooperation procedure of the EEC and as this report was being finalized the Council of Telecommunications Ministers of the 12 Member States had apparently reached the common position required for further progress of this measure.

3.4 THE EUROPEAN TELECOMMUNICATIONS STANDARDS INSTITUTE (ETSI)

ETSI has its origins in the CEC Green Paper on Telecommunications of June, 1987. The CEPT technical recommendations, which historically, have been the basis for European TA co-ordination, were not considered by the CEC as a suitable basis for the emerging competitive telecommunications environment.

It was the CEPT who initially grasped the initiative from the CEC before the ink on the Green Paper was dry. The formal foundations of ETSI was a "Memorandum of Understanding" between CEPT members of the 15th of January 1988.

This structure was confirmed by the first General Assembly of ETSI in March 1988 and the following classes of membership were established, i.e., Administrations, public network operators, manufactures, users and private service providers offering services to the public, and research organizations.

The voting mechanism at ETSI has caused some controversy. Normal voting is amongst the membership but key decisions, where consensus cannot be reached, is by national voting with country weighting and a blocking minority provision. This means that in the event of dispute, user bodies and multinational companies have no power-except where they have some influence on national voting.

The determination of national positions is left to each country with the recommendation that it should fully consult with all categories of ETSI membership. There are, however, no guidelines and as a rule the TAs tend to be the major influence at the national level.

A number of international suppliers have chosen to become directly involved with ETSI itself and have applied for separate membership from countries in which they are established. As a result, membership has exceeded expectations to the extent that neither the General Assembly nor the Technical Assembly can fit into the custom built assembly chamber of the ETSI building in Sophia Antopolis, France.

The output of ETSI consists of (European Telecommunications Standards (ETS), Interim ETS (1-ETS and Technical Reports. ETS are intended in general to be voluntary standards. They may, however, be candidates for NETS (Normes European Telecommunications) and in such cases must, when approved, be designated as mandatory within the CEC and EFTA countries. ETS will also have to be specified under the EC Procurement Directive (now in its second reading), which will be mandatory for public bodies, government agencies etc., of the CEC countries when purchasing equipment or services for which an ETS exists. It may be seen from this that the standards activities of ETSI is of interest to non-EC suppliers of telecommunications equipment.

3.5 FURTHER STEPS

A number of measures arising from the Green Paper are currently pending resolution of the controversy surrounding the Services Directive and the decision of the European Court of Justice discussed earlier in this paper.

Of particular importance will be a Commission proposal concerning the development of a satellite policy for Europe. The indications so far are that the Commission are taking a very cautious approach but nevertheless the European TAs are likely to object strongly to any proposals which might threaten their infrastructure monopoly, which is not disputed in the Green Paper.

Of no less importance are guidelines on the application of the EEC Treaty competition rules to undertakings operating in the European telecommunications sector. These are now expected in the first quarter of 1990 and promise to provide a helpful road-map for companies involved in, or dependent on, telecommunications in Europe.

4. EUROPE AND THE PACIFIC REGIONS -- A GLOBAL PERSPECTIVE

The European experience has implications for the development of the Pacific region telecommunications environment and industries. Some of the major factors which play a role in the relationship between developments in the European and Pacific telecommunications regional activities will be discussed in this section.

4.1 DEVELOPMENT OF INTRA-REGIONAL ECONOMIC TIES

With its 1992 initiative, the European region, more than any other region in the world, has enacted an intra-regional effort to strengthen its collective economy. As outlined earlier in this paper, telecommunications-related measures have been a key element of this economic regionalization effort. The recognition of economic interdependency within the 12 member states has spread to the surrounding countries as well. The EFTA countries such as Sweden, Switzerland, and Finland, and even some East Bloc nations, are watching the EC's activities very closely and positioning themselves to be successful within a Europe that is more unified in it's approaches to competition, harmonization and standards.

There is also an increasing sense of economic interdependency among the nations of the Pacific. However, like most nations in multilateral environments, political and market competition between Pacific countries tends to overshadow attempts to cooperate on a regional level. Traditionally, European countries have shared — and continue to do so to a surprising degree even with the EEC — the Pacific countries' competitive attitudes. Nevertheless, the extraordinary degree of political and economic cooperation resulting from EC 1992 is unique, as is the European Economic Community Treaty as a legal instrument. This Treaty has provided the means by which promoters of regional unity can realize their goals. Specifically, the European Commission is able to exercise it's powers in promoting competition and harmonization through anti-trust and other provisions of a commonly respected legal instrument.

In the Pacific context, is important to examine the Association for Southeast Asian Nations (ASEAN) and the Ministerial-level Asia Pacific Economic Cooperation (APEC) meeting recently held in Canberra in November, 1989. On the general economic level both ASEAN and APEC will undoubtedly serve as strong regionalization forces and provide a counterweight to economic unification movements of the EEC. However, in the area of telecommunications harmonization, market liberalization and intra-regional trade promotion, neither organization has positioned itself to play a major role.

These two regional forums are perhaps comparable to the EEC in that they represent cooperative initiatives to further intra-regional economic ties. For purposes of projecting their potential relevance to the development of regional telecommunications trading ties, it is noted that both fora have separately stated goals of strengthening intra-regional trade relationships and increasing cooperation in the telecommunications sector. However, both ASEAN and APEC have focused their telecommunications initiatives on the development of infrastructure and not linked them directly to the trade initiatives.(1)

As a result, neither organization has taken action towards creating specific economic opportunities on an intra-regional basis in the telecommunications sector.

Further, in areas of multilateral policy coordination on telecommunications issues, unlike the European nations in the EC and CEPT, neither ASEAN nor APEC has taken on the role of coordinating its members' positions in the ITU. Similar to the EC, however, APEC has agreed to close consultation among its members regarding the GATT Uruguay Round (although APEC will not actually represent its members before the GATT).

4. 2 LIBERALIZATION TRENDS RESULTING FROM THE GLOBALIZATION OF INDUSTRY

Few countries in the world have been left untouched by the overwhelming need to introduce some degree of competition into their telecommunications sector in order to satisfy growing customer demands for new technology. In most cases, this has necessitated a significant adjustment to the traditional monopoly industry structure and relevant telecommunication law. In virtually all cases, a division has been made between the types of services and equipment provided on a monopoly basis, and those provided on a competitive basis. Although each country makes this distinction somewhat differently, allowing different degrees of competition to exist, this trend seems destined to continue as user needs and technology become more specialized.

In both the European and Pacific regions, it has been the most developed countries which have introduced the greatest degree of liberalization and competition into their domestic market-places. The Pacific region is in the unique position of having a greater number of Newly Industrialized Countries (NICs) which are transitioning from underdeveloped to developed economies. Yet, the NICs do not seem eager to accept competition in their own markets, even though, in many cases, it is through successful competing in developed economies that they have earned much of their success.

Much of the support for liberalization in these countries has come from a recognition by governments that major companies in major industries such as finance and manufacturing share the need to communicate effectively between their branches and affiliates. In fact, this need is a key factor in the success of these companies. This understanding is coupled with a belief by governments that competitive providers will ensure that availability of services and equipment and meet customer needs at reasonable prices.

As is demostrated by policies which emphasize competition in service provision, the availability of quality services at reasonable prices has been recognized in North America and more recently Europe as critical to the success of the industry. However, with the exceptions of Japan, Australia and New Zealand, the liberalization of services has not yet played a prominent role in the policy development of many Pacific region countries.

In developing their services policies, all nations should follow the example of Japan and look to the increasing importance of international service liberalization and tariff re-balancing to global industries. This is an area that many countries (including the EC) have yet to address outside the fairly restrictive D Series recommendations of the ITU. Although internal country communications will continue to be very important to domestic markets, companies with international operations will rely more and more heavily on the ability to move information between countries with technical and regulatory ease. The need for international connectivity by customers will place a premium on the ability for various country policies to be flexible and liberal to accommodate the different technical and political regimes which impact in these companies' networks. The countries which ease international restrictions on telecommunications will become more attractive to these global companies looking to invest in their domestic markets.

4.3 PARTICIPATION IN MULTINATIONAL FORUMS

Geographical limitations have undoubtedly increased the difficulty with which Pacific region countries are able to be influential in the multilateral forums of the General Agreement on Tariffs and Trade (GATT) and the International Telecommunications Union (ITU), both located in Geneva. The great cultural and geographical distances, and associated costs necessary to travel from any point in the Pacific to Geneva, are relatively heavy. As it has historically affected development in multilateral telecommunications policy, participation of Pacific region countries in the ITU has clearly suffered from this problem of distance.

It is perhaps too early to project the dynamics of the GATT services talks, since discussions of any specificity on telecommunications are not scheduled to commence until mid-1990. However, as noted earlier, the European Commission plays a stronger role in representing the Community in the GATT than it does in the ITU. In the Pacific, although a different type of coordination, the APEC does have the opportunity in the next year to have a Pacific regional influence in the GATT if it so desires.

5. IMPLICATIONS FOR THE PACIFIC

The increasing globalization of the telecommunications industry and customers of telecommunications companies, have increased the potential for regional coordination to impact the global market place. While the EC has clearly responded with an unusually coordinated approach, this does not mean that a "Pacific Common Market" is necessary or even desirable. The Pacific economies have and will continue to develop the interdependencies and relationships necessary to sustain growth in the region with whatever cooperative measures are suitable.

In fact, because they are not bound to a regional body as forceful as the EC, the countries of the Pacific have perhaps more flexibility to engage in regional activities where it benefits all parties and continue their individual policies and industrial directions to excel in inter-regional trade. For example, through non-regional efforts, Japan, Hong Kong, and Singapore have succeeded in becoming economic "gateways" to the Pacific region through successful trade in goods with American and European countries. Many countries in both the Pacific and European regions have leveraged the "gateway" concept very successfully in the area of air and sea transportation as well. Japan and the United Kingdom have integrated this "gateway" model into their telecommunications services policies by consummating bilateral agreements on international telecommunications services with each other and the U.S., thereby securing a link to each other and U.S. telecommunications services markets.

Because the policies and related market structures of countries in all three regions of the Pacific, Americans, and Europe are not harmonized, it will be some time before such bilateral ties and agreements become true gateways between regions for telecommunications and telecommunications-dependant industries. For the moment, these agreements benefit primarily the countries that have signed them. When more bilateral arrangements exist, however, the economies of certain routes and traffic patterns will emerge and gateways will become more common. Unlike other industries, such as the transportation industry, for which an analogy seems appropriate, telecommunications costs are less distance-sensitive, and the flexibility of the regulatory climate is a more critical factor to the development of such gateways. Regulatory regimes which provide incentives for providing or using international telecommunications services will become the natural gateways between regions.

Although the existence of organized Pacific regionalism on the level of the EC seems unnecessary in developing global ties via gateways, there are some areas where the Pacific countries could benefit more from a regional approach. Namely in the multilateral forums of the GATT and ITU. In these organizations it is the ability to create consensus which is the key to influence. As mentioned above, the Europeans have made great progress out of marshalling such regional forces in the ITU, and they also hold the promise of substantial influence in the GATT. And also as noted above, the Pacific has regional organizations at its disposal to use in creating such a consensus approach to the ITU and the GATT on telecommunications issues.

6. CONCLUSIONS

6.1 Rather than representing a "Fortress Europe" to keep out Pacific and American firms, the EC's 1992 initiatives in telecommunications should be viewed as a significant business opportunity. On the general level, EC 1992 will lead to a stronger, more healthy economic environment. Specifically, the Terminal Equipment and Services Directives create the opportunity for services and equipment providers to sell in European markets, some of which were previously almost exclusively served by PTTs and their chosen suppliers. It is estimated that the equivalent of $500 to $1,000 billion U.S. will be invested in European telecommunications markets by the year 2000 (2). Much of this money will be spent by customers who want to take advantage of their new opportunity for choice.

6.2 The EC's 1992 telecommunications initiatives and subsequent harmonization will further strengthen its global influence in the major multilateral organizations and the commercial marketplace. Within the CCITT especially, Europe's regional influence, supported by the recently-created ETSI, will have a major impact in the creation of international standards. Already, in the trade realm of the GATT, the Pacific nations have moved towards increasing their regional consultation and cooperation in holding their first APEC Ministerial meeting last November. There is an increasing need for the expansion of such regionalism to be considered in the areas of technical cooperation, standardization and intra-regional trade relationships.

6.3 The European model cannot realistically be applied to the Pacific region but a great deal of value can nevertheless be gained from the European experience. Many of the telecommunications developments now taking place in Europe are specifically aimed at removing barriers to trade across national boundaries and could be of economic and social benefit if paralleled in the Pacific region. For example:

- mutual recognition of type approval and conformance testing for terminal equipment; throughout the region;
- creation of a regional telecommunications standards organization where all the interests are carefully and fairly balanced;
- harmonization of electromagnetic compatibility (EMC);
- regional work on the development of trade related subjects (e.g.) Electronic Data Interchange (EDI, OSI, data protection);
- common rules for standardizing network access has been done with ONA in the U.S. and ONP in the EC;
- transborder tariff studies and the development of tariff principles; and
- involvement of all interest parties (TAs, users, suppliers, unions, and consumers) in open debates concerning the development of regional telecommunications policy.

6.4 In the absence of, or in parallel with, a Pacific regional effort in the area of telecommunications, Pacific nations should consider the benefits of bilateral arrangements with countries in Europe and the Americas. In addition to creating metaphorical and actual "ties between regions," such agreements allow Pacific countries to benefit from the harmonization and increased trade opportunities created by EC 1992 that will result in a large integrated European market. In addition, due to the size of the European Common Market, individual Pacific countries may well have more to gain from such arrangements than individual European or North America countries.

The role of bilateral agreement between countries in different regions will continue to grow in importance as regional coordination advances more rapidly than multilateral global coordination. Such bilateral ties should facilitate agreements at the multilateral level rather than replace them.

6.5 Finally, closer ties on telecommunications related matters within the Pacific region would be beneficial now and seem likely to become an economic necessity. Specifically greater cohesion in multilateral government activities such as at the CCITT and the GATT is of particular importance.

CITATIONS

[1] "The Manila Declaration of 1987", ASEAN Newsletter, The Asean Secretariat Publication No. 24, November/ December, 1987. And also, "Specific Elements of A Work Program" (D. Sectoral Cooperation), Australia Background on APEC, Austalia Overseas Information Services, Embassy of Australia, Washington, D.C.

[2] "Dr. K.H. Narjes, CEC International Consultative Forum on the Green Paper, February, 1988.

ATTACHMENT

THE CEC'S GREEN PAPER PROPOSALS

A. Exclusive infrastructure provision by Administrations.

Acceptance of continued exclusive provisions or special rights for the Telecommunications Administrations regarding provision and operation of the network infrastructure. Where a Member State chooses a more liberal regime, either for the whole or parts of the network, the short and long term the integrity of the general network infrastructure should be safeguarded.

Closely monitored competitive offering of two-way satellite communications systems will need further analysis. It should be allowed on a case-to-case basis, where this is necessary to develop European-wide services and where impact on the financial viability of the main provider(s) is not substantial.

Common understanding and definition regarding infrastructure provision should be worked out under E) below.

B. Exclusive provision by Administrations of certain reserved services.

Acceptance of continued exclusive provision or special rights for the Telecommunications Administrations regarding provision of a limited number of basic services, where exclusive provision is considered essential at this stage for safeguarding public service goals.

Exclusive provision must be narrowly construed and be subject to review within given time intervals, taking account of technological development and particularly the evolution towards a digital infrastructure. "Reserved services" may not be defined so as to extend a Telecommunications Administration service monopoly in a way inconsistent with the Treaty. Currently, given general understanding in the Community, voice telephone service seems to be the only obvious candidate.

C. Free Competition For All Other Services

Free (unrestricted) provision of all other services ("Competitive services", including in particular "Value-added services") within Member States and between Member States (in competition with the Telecommunications Administrations) for won use, shared use, or provision to third parties, subject to the conditions for use of the network infrastructure to be defined under E).

"Competitive services" would comprise all services except basic services explicitly reserved for the Telecommunications Administrations (see B).

D. Standards for Infrastructure and Services

Strict requirements regarding standards for the network infrastructure and services provided by the Telecommunications Administrations or service providers of comparable importance, in order to maintain or create Community-wide inter-operability. These requirements must build in particular on Directives 83/189/EEC and 86/361/EEC, Decision 87/95/EEC and Recommendation 86/659/EEC.

E. Open Network Provision (ONP)

Clear definition by Community Directive of general requirements imposed by Telecommunications Administrations on providers of competitive services for use of the network, including definitions regarding network infrastructure provision.

This must include clear interconnect and access obligations by Telecommunications Administrations for trans-frontier service providers in order to prevent Treaty infringements.

Consensus must be achieved on standards, frequencies, and tariff principles, in order to agree on the general conditions imposed for service provision on the competitive sector. Details of this Directive on Open Network Provision (ONP) should be prepared in consultation with the Member States, the Telecommunications Administrations and the other parties concerned, in the framework of the Senior Officials Group on Telecommunications (SOG-T).

F. Unrestricted Provision of Terminal Equipment

Free (unrestricted) provision of terminal equipment within Member States and between Member States (in competition with Telecommunications Administrations), subject to type approval as compatible with Treaty obligations and existing Directives. Provision of the first (conventional) telephone set could be excluded from unrestricted provision on a temporary basis.

Receive Only Earth Stations (ROES) for satellite down-links should be assimilated with terminal equipment and be subject to type approval only;

G. Separation of Regulatory and Operational Functions

Separation of regulatory and operational activities of Telecommunications Administrations. Regulatory activities concern in particular licensing, control of type approval and interface surveillance of network usage condition;

H. Review of Administration Commercial Activites

Strict continuous review of operational (Commercial) activites of Telecommunications Administrations according to Articles 85, 86 and 90, EEC Treaty. This applies in particular to practices of cross-subsidization of activities in the competitive services sector and of activities in manufacturing;

I. Review of Private Providers Activites

Strict continuous review of all private providers in thenewly opened sectors according to Articles 85 and 86, in order to avoid the abuse of dominant position;

J. Full Application of Community Commercial Policy

Full application of the Community's common policy to telecommunications. Notification by Telecommunications Administrations under Regulation 17/62 of all arrangements between them or with Third Countries which may affect competition within the Community. Provision of information to the extent required for the Community, in order to build up a consistent Community position for GATT negotiations and relations with Third Countries.

COMMUNICATION SERVICES IN THE WORLD

Thierry Bonhomme, André Lange, Didier Pouillot
IDATE, France

1. ABSTRACT

The layout follows that of the four sectoral analyses which are :

- telecommunication equipment : world markets and industries ;
- telecommunication services in the world ;
- computer services and software in the world ;
- world audiovisual market.

These four sectors generated a global turnover of more than 500 billion US dollars in 1988 ; they share a common feature of far outstripping the mean growth rate of the world economy, and the service sector in particular ranks among the best performers.

The purpose of this brief presentation is to introduce the reader to the significance of such developments and to provide a map to guide him through the strategies at work in these areas.

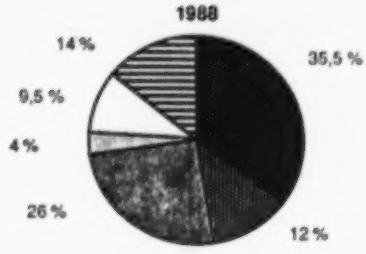
2. TELECOMMUNICATIONS EQUIPMENT

2.1.

Although the market is still highly focusing on the OECD countries, it is gaining ground towards Eastern Europe and developing countries, the weight of these two blocs rising from 21% to 37% in 2000.

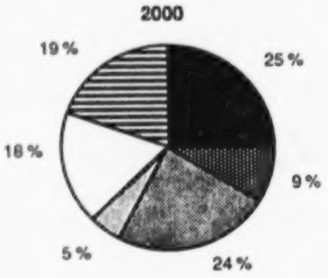
Among the last countries, South East Asia still represents the strongest market whereas Latin America and Africa, which are presently lagging behind, are getting closer.

Market by geographic area



Global market = $ 88 Bn

- ■ US, Canada
- ▩ Japan
- ▨ EEC
- ▥ Other OECD
- □ Eastern Europe
- ▤ Developed countries



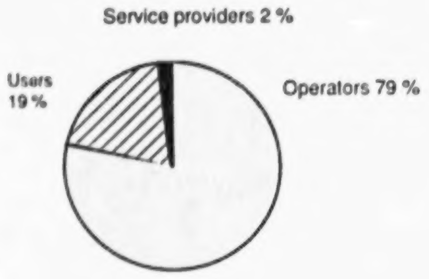
Global market = $ 170 Bn

2.2.

Public operators account for about 4/5 of the demand ; this explains the major manufacturers' weight on the worldwide industry (cf. infra).

The users represent the other market share ; they are gradually gaining ground. But the most noticeable evolution concerns the value-added service providers who should consume about 7% of the world production by the year 2000.

Telecommunications demand in 1988



Global market 1988 = $ 88 Bn

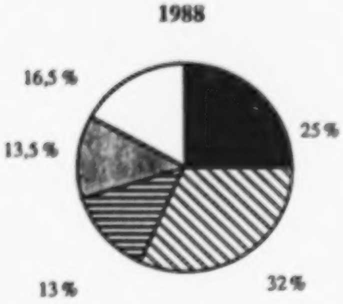
Source : IDATE

2.3.

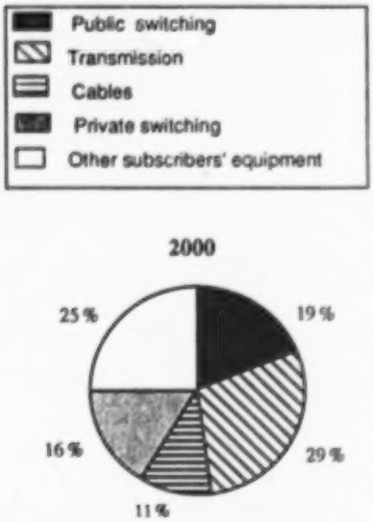
Today, the telecommunications industry is made up of public network equipment for 70% and of private equipment for 30%.

By the year 2000, the public equipment share will fall to 60% whereas the private equipment (switching...) will fully benefit from the rapid development of data transmission networks.

World market by product



Global market = $ 88 Bn



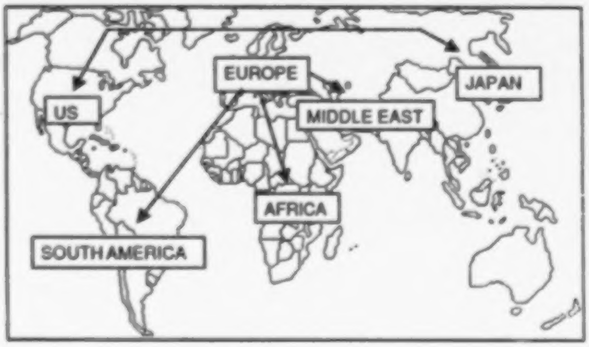
Global market = 170 Bn

Source : IDATE

2.4.

From one area to the other, exchanges remain quite restricted because of the protectionist and standard barriers. With NTT showing their willingness to a broader opening since their privatisation, Japan in particular, goes on ordering little outside and on the contrary, supplying a lot.

On the opposite, the United States, though its production is equal to half of the world production, is still in deficit.



Source : IDATE

2.5.

AT&T is dominating the market, benefiting among others from an internal sales market of about $4 billion.

Behind AT&T, Alcatel and Siemens take the lead in the European ranking and three other public manufacturers are just behind. In total, those six manufacturers represent about half of the worldwide market.

Then come the public manufacturers involved in smaller areas (Italtel, GEC ...) or specialized manufacturers (Motorola, IBM...).

The 10 leading manufacturers in the world

($ in billion)	Telecom. revenue	Change 87 %	Global revenue
AT&T (US)	11409	7	35210
Alcatel (Netherlands)	8933	5	13142
Siemens (Germany)	7543	1	34123
NEC (Japan)	6526	6	24036
Northern Telecom (Canada)	5407	10	5407
Ericsson (Sweden)	3738	27	5108
Motorola (US)	3020	23	8250
IBM (US)	2800	12	59681
Fujitsu (Japan)	2501	17	15629
GTE (US)	1831	17	16460

Source : IDATE

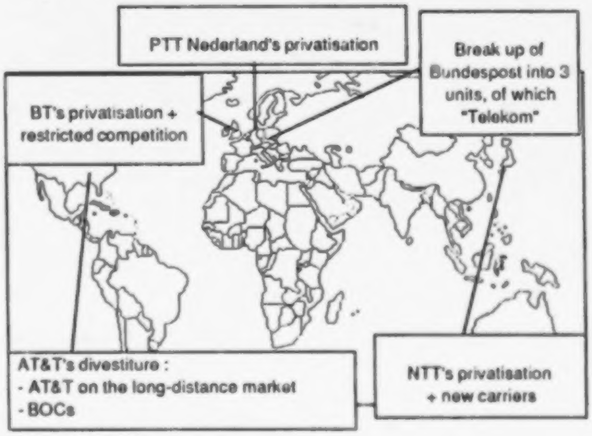
2.6.
For five or six years now, the telecommunications industry has experienced a large restructuration (joint ventures, mergers...), often involving first rank manufacturers. AT&T, Alcatel, Siemens rank among the main players, thus increasing the concentration on this sector.

The main telecommunications movements

Date	Players	Nature of movement
1984	AT&T Philips	joint venture : APT (renamed ATT NSI in 1988)
1987	Alcatel France ITT Europe	Merger between Alcatel and ITT Europe : Alcatel NV
1987	GEC Plessey	Joint venture : GPT
1987	Matra Ericsson	Purchase of CGCT's public activity, renamed MET
1989	AT&T GTE Siemens Rolm	Joint venture in the public switching field Purchase of Rolm, a US PBX manufacturer (belonging to IBM since 1984), by Siemens
1989	AT&T Italtel	Cross participation agreement, in order to modernize the Italian network
1989	GEC/Siemens Plessey	success of GEC/Siemens bid over Plessey (Siemens takes 40 % of GPT)

3. TELECOMMUNICATIONS SERVICES

3.1.
Since the beginning of the 80's, the telecommunications world has been shaken by continual regulatory upheavals, either taking a harsh shape as for example the divestiture in the US or softer shapes (public operator's privatisation as in the United Kingdom and Japan and restricted introduction of competition).

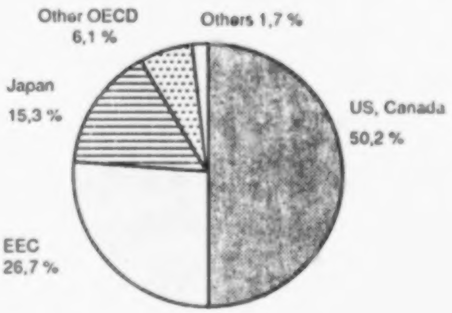

PTT Nederland's privatisation
Break up of Bundespost into 3 units, of which "Telekom"
BT's privatisation + restricted competition
AT&T's divestiture :
- AT&T on the long-distance market
- BOCs
NTT's privatisation + new carriers

Source : IDATE

3.2.
In 1988, the telecommunications service market represented about $300 billion, out of which North America accounted for around a half ; then , EEC with more than a quarter and Japan (15%).

The countries outside OECD whose weight in financial volume remains quite light, are going to develop in a noticeable manner in the next years, thanks to the rise in equipment and to the economic development.

Markets by area



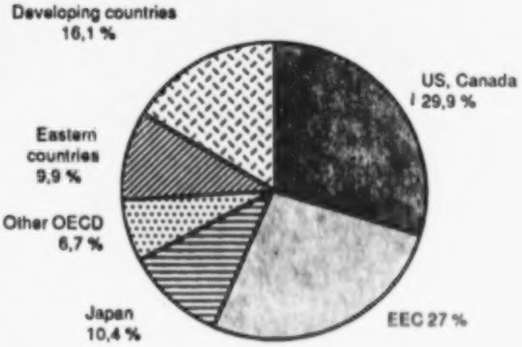
Global market 1988 = $ 300 Bn

Source : IDATE

3.3.
The telephone service remains, by far, the first of the telecommunications services. Its weight oscillates between 80 to 90% of the amount according to the areas.

The number of access lines, from 480 million in1988, should double in the next 12 years : some areas, like USSR and China, should concentrate a large part of this growth.

Number of access lines



Number of access lines in 1988 =480 M

Source : IDATE

3.4.
Nevertheless, the new services are regularly gaining ground :

- the cellular radio is undergoing a strong infatuation,

- the data transmission and particularly the value-added networks are increasing very quickly,

- ISDN discloses its first applications.

Mobile radio in Europe

	Subscribers (June 89)	Subscribers/1000
UK	650 000	11,5
Sweden	295 500	35,2
Norway	161 230	38,4
France	135 870	2,5
Finland	131 610	27,4
FRG	123 980	2,0
Denmark	112 830	21,7
Switzerland	51 540	8,6
Italy	46 850	0,8
Austria	44 250	5,8
Netherlands	43 400	3,0
Belgium	21 200	2,1
Spain	20 700	0,5
Ireland	7 570	2,2
Island	7 280	30,3
Portugal	1 400	0,1
Others	1 870	Source : IDATE
Total	**1 857 080**	European Mobile Com.

3.5.
The structure of the sector (historical monopolies) leads to an operators' classification which follows, in its main lines, the economic situation of the countries in which they are involved. Except the US, with a divided up market, it is not surprising to find NTT at the top, and afterwards, on the European plane, the German, British and French operators.

Over the US, Bell System as a whole (AT&T and BOCs) have a turnover exceeding $100 billion.

88 ranking of the top 10 worldwide operators

($ in billion)	Revenue from telecom services	Change 87 (%)	Total revenue 88
NTT (Japan	43,3	3	43,3
AT&T (US)	23,9	1	35,2
Deutsche Bundespost (FRG)	20,9	1	29,9
British Telecom (UK)	19,2	9	19,6
France Télécom (France)	15,1	ns	15,1
BellSouth (US)	13,6	11	13,6
Nynex (US)	12,7	5	12,7
GTE (US)	11,7	5	16,5
Bell Atlantic (US)	10,9	0	10,9
Ameritech (US)	9,9	4	9,9

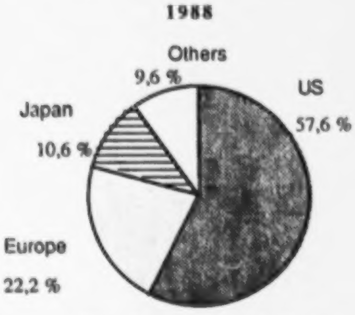
4. DATA PROCESSING SERVICES

4.1.

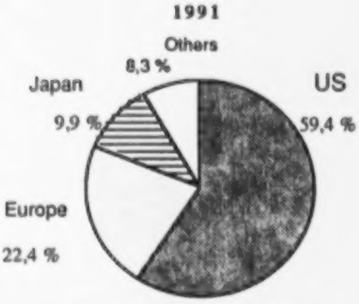
Assessed at $ 146 billion in 1988, the world data processing services market is greatly dominated by the US (for almost 60 %), then come Western Europe for more than 20 % and Japan (11 %).

Within three years, the market should increase by over 60 % (19 % per year), the US emphasizing their domination.

Market by geographic area



Global market = $ 246 Bn



Global market = $ 246 Bn

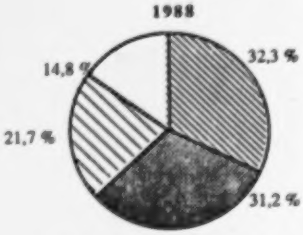
Source : IDATE

4.2.

Taken as a whole, intellectual services (soft-ware, package software, system engineering, consultancy and advising, training) are supplanting the machine services (batch processing, teleprocessing, facilities management), whose weight varies between 30 % and 50 % according to the areas.

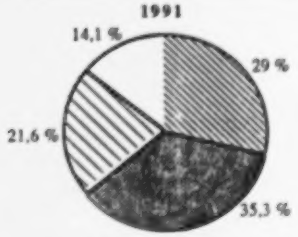
Among those machine services, the facilities management however is developing rapidly. Some processing operations, such as financial transactions, also show a very strong dynamism.

The US market



Global market = $ 84 Bn

▨ Processing services
■ Software
▧ Professional services
☐ Integrated systems



Global market = 148 Bn

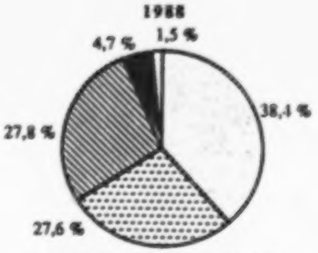
Source : IDATE

4.3.

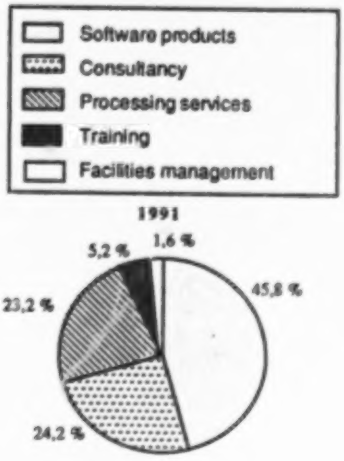
In proportion of the size, the European market is the least developed of the three main areas, however it is the most brain oriented. Indeed, intellectual services (package soft-ware, consultancy train-ing) exceed 70 % and should go beyond 75 % within 3 years.

On the contrary, the machine services are still heavy in Japan and their impact is lessening very slowly.

The European market



Global market = $ 32,4 Bn



Global market = 55,3 Bn

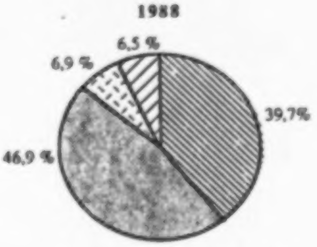
Source : IDATE

4.4.

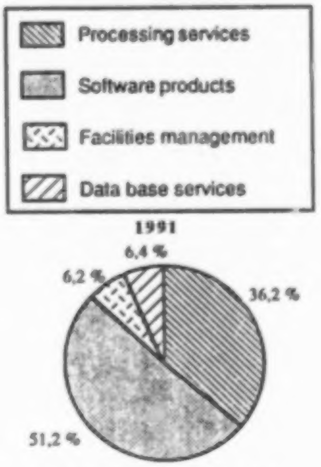
The main developments in this sector concern :

- standardization with the debate about operating systems ;
- database management with the development of relational systems ;
- artificial intelligence with its first application on expert systems ;
- software engineering to make easier and speed up the production cycle of software.

The Japanese market



Global market = $ 15,4 Bn



Global market = $ 24,3 Bn

Source : IDATE

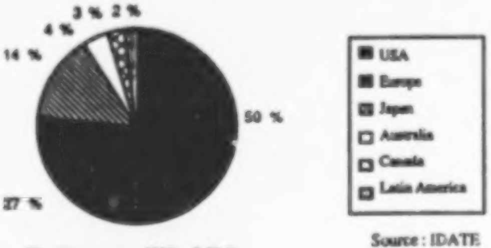
5. AUDIOVISUAL INDUSTRY

5.1.

With the launching of the EUREKA Audiovisual programme and the adoption of the Community Directive "Television Without Frontiers", Euro-American relations have entered a new phase. Following the example of the European Convention on Transfrontier Television prepared for signature last spring in the Council of Europe, the Directive carries no mention of broadcasting quotas but of political commitment on the part of member states aimed at inducing broadcasters to programme audiovisual works mostly of European origin. Despite the rather unrestrictive character of the Directive, the United States has announced its intention to denounce before GATT a text it considers protectionist.

The arguments employed by the Europeans to justify these measures are mainly of a cultural nature. It is, however, necessary to take stock of what we know and what we do not know about the economic aspects of an international audiovisual exchange. During the most recent MIP-TV, the heads of American audiovisual companies accused the press of publishing exaggerated figures relating to the amount of revenue deriving from the international market and, in particular, from the European market. While awaiting the creation of the European Audiovisual Observatory, which should constitute the first concrete manifestation of the Eureka audiovisual programme and allow for a more precise approach to the question, IDATE presents some figures showing the structural changes which have occurred in the international audiovisual economy.

Turnover shares of the top 100 audiovisual companies in the world in 1988



World turnover 1988 = $ 58 Bn

Source : IDATE

5.2. Statistical gaps

An evaluation of the USA/EEC trade balance in the audiovisual sector, which is an indispensable operation in the preparation of future negotiations, is made difficult by the absence of exact statistics.

The situation in the USA

- the MPAA (Motion Picture Association of America) keeps its statistical data confidential. The only figures published annually in Variety are those relating to the worldwide sale of cinema theatre tickets;
- the AFMA (American Film Marketing Association), federation of independent producers, is the only body to publish detailed statistics on its sales in the various international markets;
- the US Department of Trade publishes detailed statistics but as far as we know, the latest available figures are for 1984, that is to say the year before deregulation became widespread in Europe. According to this source, sales of audiovisual programmes in Europe in 1984 represented 14.1% of the sales of services (excluding banking services) achieved by US subsidiary companies in Europe.

The situation in Europe

- statistics relating to income from the world market are disparate, unharmonised and fragmentary. Europe is heavily dependent on American sources (official, professional or established by American consultants) for information on its own market and on its sales in the US market. The figures which we present are thus estimates and should be considered with all proper reserves.

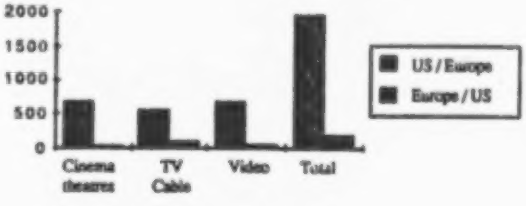
5.3. Evaluation of the US/EEC trade balance in the audiovisual sector (1988)

Cinema theatres	
US industry revenue in Europe (EEC)	$693 million
European industry revenue in the USA	$43 million
Television (including cable and pay TV)	
US industry revenue in Europe (EEC)	$575 million
European industry revenue in the USA	$100 million
Video programmes market	
US industry revenue in Europe (EEC)	$700 million
European industry revenue in the USA	$60 million
Total	
US industry revenue in Europe (EEC)	**$1968 million**
European industry revenue in the USA	**$203 million**

Audiovisual trade balance USA / EEC in 1988 = $ 1.8 billion

Source : IDATE from data compiled by MPAA, AFMA, Goldman Sachs and various national sources in Europe.

Comparison of US revenues in the European market and European revenues in the US market in 1988 ($ in million)



Source : IDATE

5.4.The consequences of television deregulation in Europe

The US statistics confirm what the observers pessimistically sensed, namely that the creation of second markets in Europe mainly benefits American producers rather than permit the development of a European audiovisual industry. In 1988, for the first time, the US audiovisual industry obtained more revenue from the world television market than from its home market. Between 1984 and 1988, revenues obtained by independent producers in the French television market increased by 931% (from $0.5 million to over $38 million), and from 1983 to 1988 the revenues of these producers from the total European audiovisual market increased by more than 400% (from $111.5 million to $561 million).

Revenues of US independent producers from the European audiovisual market ($ in million)

EUROPE	1983/84	1984/85	1985/86	1986/87	1987/88	1984/88
Theatres		111,488	101,748	187,951	217,136	94,8 %
TV, Cable		39,225	67,018	58,868	143,33	265,4 %
Video		98,625	90,494	141,596	200,774	103,6 %
Total	111,5	249,338	259,26	388,415	561,24	125,1 %

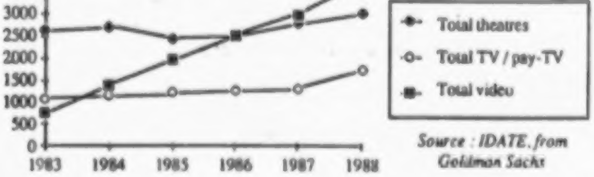
FRANCE	1983/84	1984/85	1985/86	1986/87	1987/88	1984/88
Theatres		18,713	8,622	22,278	31,093	123,8 %
TV, Cable		0,563	4,571	6,353	38,357	931,8 %
Video		19,05	15,626	14,329	14,38	-24,5 %
Total	18,7	38,325	28,819	42,96	83,83	118,7 %

Source : IDATE from AFMA

5.5. The appearance of video as a principal source of financing

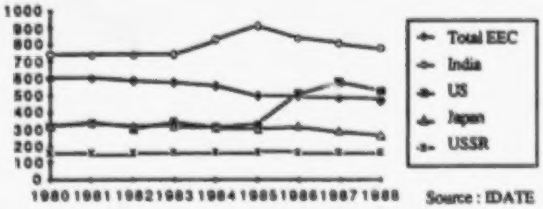
The appearance of video as a principal source of financing the American audiovisual industry also constitutes one of the remarkable features of the end of the second half of the 1980s. It has permitted the development of independent production in the United States, which in 1986-87, manifested itself in a veritable boom in the number of full-length films produced. As a result, for the first time in 1986 the United States produced more full-length films than did the member nations of the European Community.

Changes in american audiovisual industry revenues on the world market ($ in million)



Source : IDATE, from Goldman Sachs

Development of full-length film production by the 5 major producer countries (1980-1988)

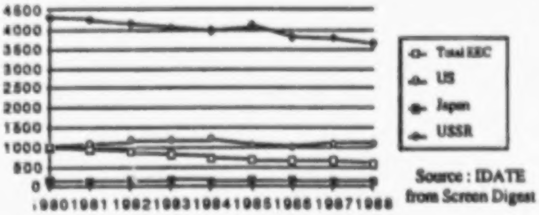


Source : IDATE

5.6. The fall in cinema audiences in Europe

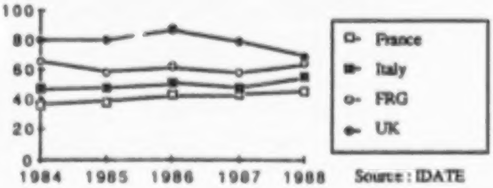
In Europe, the multiplication of television services offered to the public has been accompanied by a growing fall in cinema theatre audiences. This seems to be a European phenomenon: in the United States in the 1980s, cinema audiences have remained relatively stable. The fall in audiences in Europe is being partnered by a growing hold on distribution by American producers. The French cinema sector was the last market in Europe where national films obtained better results than American films. Since 1987, American films have dominated all the markets in Europe.

Changes in cinema theatre audiences 1980-1988 (in million of admissions)



Source : IDATE from Screen Digest

Development of full-length film production by the 5 major producer countries (1980-1988)



Source : IDATE

A NEW ACRONYM FOR ISDN :
IT SUITS DIVERSIFIED NEEDS

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FRANCE TELECOM
FRANCE

ABSTRACT

This article considers the development of ISDN in France and describes FRANCE TELECOM's strategy : fast geographical coverage, attractive tariffs, international interconnections and partnership with users and service providers. It concludes on the description of the results already achieved.

The development of ISDN requires three main actions :

-the development of the network, starting from the present state of development of the public switched telephone network,

-the development of terminals able to use the inherent capabilities of ISDN, in terms of bit rate, supplementary services, ...

-the development of applications able to fullfill present and future user's needs.

This article considers the way FRANCE TELECOM has decided to promote ISDN, the main results achieved up to now, and the perspectives of development.

1 - NETWORK EVOLUTION AND STANDARDISATION

1-1- NETWORK DEVELOPMENT

In the early seventies, FRANCE TELECOM started a long term policy for the modernisation of the telephone network. That policy was based on the extensive use of digital equipments both in terms of switching and transmission. As a result FRANCE TELECOM network is now the most digitalized network of developped countries.

In addition to this digitalization policy, FRANCE TELECOM enhanced the quality of service with the synchronisation on atomic clocks of all digital switches in operation in the network. To allow the development of sophisticated services, FRANCE TELECOM also implemented a new and powerfull signalling scheme : CCITT Common Channel Signalling System n° 7.

Those three elements led to the development of ISDN as the natural evolution of the telecommunication network and not as an overlay network. It was thus possible to open the first Commercial ISDN on december 21st 1987. NUMERIS is the commercial name of ISDN in France.

Because of the wide coverage of digital exchanges in France (ALCATEL E10 B or E10 MT), it is possible to quickly provide ISDN access on the whole territory on a cost effective way. The subscriber access unit, called CSN, has been used since 1987 to connect analog lines. The connection of ISDN lines only requires the use of a new access card within the CSN. This explains why the whole coverage of France will be effective at the end of 1990, that is only three years after the commercial opening (figure 1).

At the present time both basic rate access and primary rate access are commercially available. The ISDN accesses are opened in the whole Parisian area, and in main metropolitan cities such as Lyon, Marseille, Lille and Rennes, covering more than 50 % of potential business users. In addition NUMERIS is interconnected with pre ISDN 64 kbit/s switched digital service to allow interworking with other locations.

1-2- INTERNATIONAL INTERWORKING

When considering ISDN development in different countries, it appears that by 1990-1991 most of the countries will have ISDN services. Therefore it is very important to provide as early as possible international interconnections to fullfill business users needs.

FRANCE TELECOM has started an active policy for ISDN international interconnections since the very beginning. That policy can be split in two different steps :

- first : interworking with pre-ISDN networks. Those interconnections have been established with ATT ACCUNET 56 and United Kingdom IDA in 1988, with Finland DIGINET at the beginning of 1989.

- second : ISDN to ISDN interworking. Presently tests are on process for the interconnection between ATT in the USA and FRANCE TELECOM in France, the commercial service being scheduled for end 1989. The tests for interconnection with Japaneese ISDN will start next february with KDD. As a result interworking between Japaneese and French ISDN is scheduled for the first part of 1990. In Europe the first ISDN to ISDN interconnection will be done between Germany and France. After tests in the first quarter of 1990, the commercial service is scheduled for mid 1990. Interworking with other ISDNs, both inside and outside Europe will follow during the second half of 1990 and in 1991.

1-3- STANDARDISATION

Standardisation is a basic requirement both for ISDN development and for ISDN interconnections.

Many actions have been launched within Europe since 1984 to speed up standardization process.

Following the report of the "Analysis and Forecasting Group" (GAP) of the Commission of the European Communities (CEC) in 1984, the European Council of Ministers issued recommendation 86/659/EEC on the coordinated deployment of ISDN in the European Economic Community.

In 1985, 17 operators of the CEPT signed a memorandum of understanding on the introduction of a family of telecommunications specifications called NET which would have a compulsory character. This means that the NETS are accepted as the future European standards for mutual recognition of terminal-equipment approval and that a NET-Compliant terminal is allowed for connection on the different networks of the MOU signatories. Several NETS, such as NET3 for ISDN basic-rate access, NET33 for Telephone features of ISDN terminal equipment, NET5 for ISDN primary-rate access, are presently available or will soon be approved.

In May 1985, the General Directors of the four largest european operators : Deutsche Bundespost for Federal Republic of Germany, British Telecom for United Kingdom, ASST/SIP for Italy and FRANCE TELECOM for France set up a quadripartitite cooperation to accelerate the specification work and to plan their networks interconnection. As a result, France and Germany will be first two european countries to interconnect their ISDNs. This interworking as well as the other interworking between european countries will use the System 7 TUP + ("Telephone User Part Plus") which has been standardized by ETSI, the European Telecommunications Standard Institute.

To enlarge those interconnections, and to fullfill the European Economic Community recommandations, the four quadripartite operators have proposed a "Memorandum of understanding on the implementation of European ISDN service by 1992". This memorandum has been signed in April 1989 by 23 operators representing 18 European countries.

These interconnections will be based on the agreed standards such as Signalling System 7 TUP + and ISUP for international interconnections and NET3 and NET5 for terminal access.

Extensive work has been done to define a complete list of supplementary services to ensure their availability in the different countries.

2 -TERMINAL ASPECTS

More than one year before ISDN first commercial offering, FRANCE TELECOM opened a pre ISDN switched 64 kbit/s digital service called TRANSCOM. As a result several equipments using CCITT X21 or V35 interface have been developped. To allow the use of those equipments on NUMERIS as well as the use of equipments connected to leased line or to packet switching network, FRANCE TELECOM has developped a wide range of adaptors : X21, V35, V24, X25 and analog adaptors, those last one being used for all modem integrated equipments such as for exemple fac-simile terminals.

The large field of supplementary service available on NUMERIS (calling line identification, user to user signalling...) enhances the efficiency of communications. A full range of ISDN telephone provided by several manufacturers : ALCATEL-TELIC, MATRA COMMUNICATION, SAT is now available.

When considering users application on NUMERIS it appears that most of them use PC compatible terminals. In fact a PC with add-on boards for audio coding or for image processing, and an S interface card can be considered as the multi purpose terminal required in most applications. To facilitate the use of those equipments and to enlarge their scope of application, FRANCE TELECOM has set up an active policy to promote standards in different fields such as file transfer, ISO ADCT for image compression, image coding.

Private exchanges (PABX's) have evolved to become digital, these last years. The evolution to ISDN is for them a natural evolution. ISDN extends PABX services to the outside. The PABX becomes a genuine corporate teleport : all their features, services, applications are accessible by the other locations of the company and even by partner corporations. Thanks to the S interface, which already has a unifying role for digital telephony, all terminals may have 64 kbit/s connections,and benefit of all the network supplementary services (calling line identification, user-to-user signalling).

For all manufacturers (Alcatel Telic and Alcatel Opus, Matracom, Jeumont-Schneider, Saltelcom), large capacity PABX's, already digital and multiservices, are or will be soon enhanced to "NUMERIS" by a simple software release. In 1990-1991, the remaining part of the PABX range will be upgraded, from very low capacity (5 extensions) to medium capacities (300-500 extensions), with costs equivalent to those of analog technology.

Large computer manufacturers (IBM, DEC, BULL, HP) have realised the contribution of ISDN to their offer in communicating networks and systems. After a wait-and-see period, where ISDN was just a part of external speeches, the first pieces of equipment are appearing : add-on boards for PC, PS/2 and Mac, S2 network controllers (SNA, Decnet, Datanet), PABX front-end processors (BULL and Jeumont-Schneider). Now most of manufacturers have claimed the support of ISDN by all their equipment with native interfaces before 1992. IBM, DEC, HP, Data General, ICL, APPLE have chosen France for their worldwide ISDN development activities and will or did sign partnership agreements with FRANCE TELECOM.

How will the data processing landscape be modified by ISDN ? Contributions are numerous : speed and costs of course, but also quality (very low bit error rate, fast call set-up), security (the network guarantees the calling terminal line identification and digital transmission allows pasword exchange, encryption, and closed user-groups) and reliability (line monitoring). "NUMERIS" is a new reliable data network with flexibility and costs of telephony.

3 -SERVICE ASPECTS

The results of the different market studies made on ISDN have shown two main results. **First** there is not a single ISDN market but several ISDN markets according to the size of the companies involved. **Second** there are many application fields where users have urgent needs and are looking for quick solutions.

3-1- PARTNERSHIP

Seven years ago, FRANCE TELECOM decided to promote videotex services and started the development of minitel services in partnership with service providers. Such a strategy lead to the gigantic development of more than 10 000 videotex services for more than four million minitels.

Now FRANCE TELECOM considers that NUMERIS brings a new opportunity to develop services. Therefore a partnership policy has been set up with customers, service providers, manufacturers and installers. Most of partnership ventures are signed between a user, a service provider and FRANCE TELECOM. The user defines his needs, the service provider brings its competences and develops the application, FRANCE TELECOM facilitates the development of the whole application and may finance a part of the developments (figure 2).

Up to now 29 partnership contracts have been signed with customers coming from many different activity sectors (figure 3).

The objectives of this policy are the following :

- to identify solutions able to answer customer needs,

- to promote ISDN by developing its notoriety and its knowledge,

- to generate new connections and traffic to develop the network.

To be accepted by FRANCE TELECOM, the project must fullfill three criteria :

- it should be innovative and able to exploit ISDN capabilities (high bit-rate, use of supplementary services, use of two simultaneous calls...),

- it should be commercially realistic. A complete business plan should be elaborated and should show the return on investment and the benefits of the use of NUMERIS instead of alternative solutions,

- it should be generalisable. By simple environment changes, it must be usable in other activity sectors. The product should be commercialised by the service provider involved in the contract.

It is now possible to draw the main lessons of this policy because most of those partnership contracts are now operational.

- First the importance of image and document transfer has to be noticed. Such information transfer were impossible before ISDN because of the lack of cost effective switched 64 kb/s transmission means.

- Second the large diversity of activity sectors involved in ISDN has to be considered, going from real estate agencies to medical, from banking and insurance to tour operators, from press sector to computer aided design, from pharmaceutical companies to oil companies. The use of ISDN enhances the communication efficiency of the companies involved in those applications and therefore optimizes their position towards their competitors.

- Third, the main role of personnal computer which is used in all the different projects. Add-on boards for ISDN-S interface, for image processing, for high layer software such as I S O ADCT compression algorithms, STUTEL or FTAM file transfer protocol are now available at affordable price to build multimedia terminals.

- Last but not least, it has to be noticed that ISDN does answer existing needs. The main reason for such a quick development of applications in various activity sectors is that those applications were potential projects but were not able to be implemented because of inadequate or too expensive telecommunication means before ISDN was available on a large coverage.

In addition to all those actions, FRANCE TELECOM is actively promoting international use of ISDN, both towards ISDN users and towards other telecom operators. It has to be noticed that FRANCE TELECOM and German DBP-TELEKOM are working together on this scheme to develop applications between the two countries.

3-2- FIRST RESULTS

After eighteen monthes of partnership 29 contracts had been signed. Now all of them are fully operational.

The first analysis of those applications shows four main categories (figure 4).

Image applications

One third of the applications fall in this category

In all those applications an image data base is used, either integrated in an existing videotex data base or connected to this last one. The terminal used in users' premises are PC with S interface board plus an image board.

According to the application characteristics, different levels of image definition may be used : medium definition for real estate photographs or video telesurveillance, high definition for news image transfer, very high definition for medical images sent from a remote hospital to a central hospital.

It has to be noted that if at the beginning various de facto standards, such as VGA, have been used, now new applications are selecting the new ISO ADCT standards which will facilitate the spreading of those applications because of compatibility.

Document applications

This category covers 25 % of the applications and gathers many different document transfers going from pharmaceutical documentation to oil documentation, from document transmission between state libraries to order management for computer equipments.

Most of those applications have been defined to enhance the efficiency of document searching. The benefit of those applications is rather obvious :

- in case of pharmaceutical documentation for example, ISDN replaces the old system which required approximatily one month from the moment when a doctor inquires the pharmaceutical company up to the moment he received the document by post after a lengthy search of information. Now as soon as the employees of the pharmaceutical company have received the doctor questions, they instantaneously access the relevant document in the data base and automatically send it by post to the doctor. This one will then receive the information in less than two days.

- in case of state libraries system, ISDN replaces the old system which, each time a student asked a given document in a remote library, required to transmit a postal request to a central library which was supposed to store the document. It was then necessary to wait several days before the document was sent to the remote library.

  Now with NUMERIS, when the remote libray clerk has received the student request, he automatically accesses the data base of the central library and selects the requested document. This one is then transmitted automatically by groupe 4 fax to the remote library and can therefore be given to the student in few minutes instead of several days.

  Similar examples may be considered in all the other sectors.

Data applications

20 % of the applications fall within this category. This one gathers point of sales applications as well as accounting applications, software loading as well as CAD files transfer for printed circuit boards.

In those applications, ISDN provides the large 64 kbit/s transfer capability which allows to transmit information which were unforeseen even few years ago, in a cost effective way. In addition it provides enhanced security which is a fundamental prerequisite for applications related to funds transfer.

Multimedia applications

This category gathers 20 % of applications, going from remote teaching to audiovisual advertising in department stores, from audiovisual training of employees to horse betting.

In those applications ISDN provides the capability of simultaneous connections on the basic rate access.

This last category can be considered as the emerging part of new applications that up to now were limited to potentiality but which become reality thanks to ISDN.

These applications facilitate the development of new communication means and open new perspectives for people to people or people to machine communication

3-3- THE SUCCESSIVE STEPS IN ISDN USAGE

We have seen that ISDN did provide a wide range of services. Let us consider how those potentialities are set in use by business users. Three main steps might then be considered for the ISDN usage in case of large companies :

- In the first step, those companies start to use ISDN for a specific applications. The main characteristics of such a project are the following : first the existence of immediate needs, second the capability to define a limited, cost-effective and easy to implement project. Such project should not question the existing corporate network communication but, on the contrary, should be quickly operational.

Examples of such applications are image videotex when several videotex services have already been used within a company. The information flows being well managed, it is easy to enhance an existing videotex services by high definition images coming from an image data base connected to the existing videotex data base. Such events occurs in many activity sectors.

- The second step is related to voice and data integration. Large companies have get used to voice and data integration on leased lines to develop a digital private network between their main locations. ISDN provides them the opportunity to enlarge this integration to the other locations involved because of the large capabilities of public switched network.

It has to be noticed that many factors are now available to facilitate such an integration :

- availability of single workstation integrating telephony and computer,
- ISDN cabling standards compatible with existing cabling systems,
- availability of existing standards between the computer world and the PABX (ECMA standards).

At the time of PABX renewal, such an opportunity is often caught, all the more that all PABX manufacturers have or will have in the next monthes ISDN compatible

- In the third step, ISDN is fully merged within the architecture of the corporate network. The various needs carried by a corporate network are split amongst the three main bearer network which are digital leased lines, packet switched network and ISDN. The planning for the definition of this architecture requires 2 or 3 years before it starts to be available.

The architecture of the corporate network is thus defined to optimize the use of each different telecommunication means :

- digital leased lines for the high traffic links between the main locations,
- packet switched network for long transaction oriented applications,
- ISDN for fast file transfer and all the applications between the locations which are not accessed by leased lines because of not sufficient capacity or by packet switched network. In addition ISDN is used for all the relationships with customers, subcontractors, dealers.... At a time when most of the companies intend to develop their commercial network, NUMERIS provides a unique opportunity to build a powerfull and flexible communication means between the different partners.

Besides this step by step evolution of large companies ' ISDN usage, ISDN also fullfills needs of medium size ans small size companies.

In case of medium size companies, ISDN provides a means to enhance and develop their applications at better costs. Those companies have presently small switching systems and several dedicated accesses to specialized networks such as TRANSFIX digital leased lines, TRANSPAC packet switching network, telex network, ... NUMERIS facilitates the rationalization of their networks and offers an opportunity for cost saving.

Besides, it provides them with all the supplementary services and thus facilitates their integration in networks gathering them with other companies.

An important number of small companies and professionals is now used to deal with digital information , because of the large development of PCs on one hand and of Minitel on the other hand. Up to now, they used non automatic means to transmit their information : mail, private carrier,... Now, NUMERIS brings them new and powerfull solutions which are fully integrated within their usual way of work.

When considering the reasons for migration towards NUMERIS, those different sized companies list several key elements :

-the cost effectiveness of the solution provided by NUMERIS, compared to other solutions,

-the absence of geographical constraints , because of the very quick ISDN coverage in France,

-the capability to use existing equipments via terminal adapters.

- PABX.

4- CONCLUSION

The capabilities brought by a new telecommunication means require several years before being fully utilized. From the very beginning of ISDN development in France, FRANCE TELECOM has lead several actions in parallel :

-on the network side :

.fast development of the network in less than three years from 1987 to 1990,

.development of international interconnections with other ISDNs to fullfill requirements of business users.

-on the service side :

.definition, well in advance, of attractive tariffs.

.development of partnership with users and service providers to promote new applications.

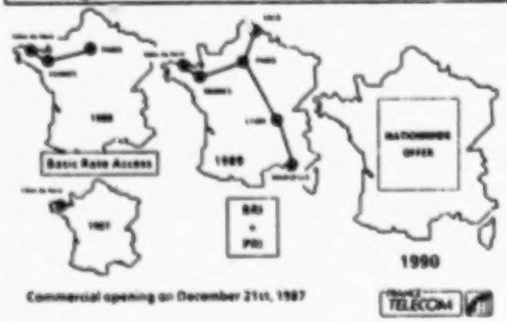
As indicated in this paper, the first results are now available. They all show that ISDN provides a very significant opportunity for business communications, both for the enhancement of existing applications such as telephony services and data services with the whole set supplementary services, and for the development of new services such as those promoted by partnership.

At a time where users are more and more considering networking aspects, ISDN provides a unique opportunity to globally consider all the service aspects of business users.

Taking into account the important results already achieved in the development of NUMERIS, FRANCE TELECOM knows for certain that :

" I.S.D.N. : It Suits Diversified Needs ".

Fig 1 : NUMERIS-ISDN:SCHEDULE


1987
1988
Basic Rate Access
1989
BRI
+
PRI
NATIONWIDE
OFFER
1990
FRANCE TELECOM

Commercial opening on December 21st, 1987

Fig 2 : NUMERIS-ISDN : PARTNERSHIP

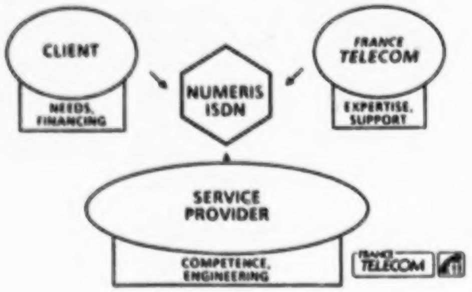
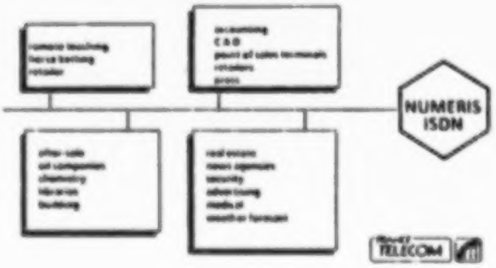

CLIENT
NEEDS,
FINANCING
NUMERIS
ISDN
FRANCE
TELECOM
EXPERTISE,
SUPPORT
SERVICE
PROVIDER
COMPETENCE,
ENGINEERING
FRANCE TELECOM

Fig 3 : MARKET SEGMENTS


NUMERIS
ISDN
FRANCE TELECOM

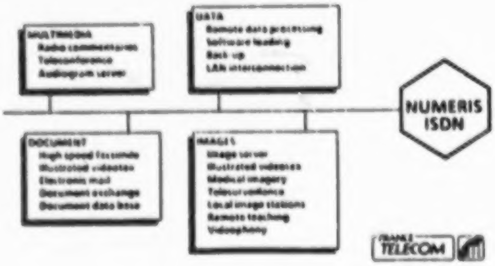
remote teaching
home banking
retailer

accounting
CAD
point of sales terminals
retailers
press

after-sale
oil companies
chemistry
libraries
building

real estate
news agencies
security
advertising
medical
weather forecast

Fig 4 : PARTNERSHIP FIRST RESULTS


NUMERIS
ISDN
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USER BENEFITS FROM PRIVATE INTERNATIONAL CARRIERS

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The FCC's deregulatory campaign has created a new category of service provider authorized to operate free of conventional common carrier duties. While emprirical evidence supports the Commission's view that such carriers can enhance user welfare, such a unilaterally created concept creates asymmetry in telecommunications policies between the United States and most foreign nations. FCC actions, which fail to appreciate the limited range of domestically generated policies, exacerbate the fundamental differences in national telecommunications policies. This paper reviews the FCC's effort to create a new category of international facility and service provider with an eye toward determining how non-common carriers can find legitimacy and market share.

The Federal Communications Commission ("FCC") has undertaken an extensive domestic campaign to foster market entry, service diversity, downward rate pressure and deregulation. Having generated measurable consumer benefits, the Commission has attempted to extend many of these internationally. Often such efforts have met with foreign opposition, and allegations that the United States has failed to respect nations' sovereignty and to understand fundamental differences between the permissible reach of domestic versus international telecommunications policies.

The FCC's creation of a new class of telecommunications facility and service provider, the "private carrier," [1] typifies the clash of national philosophies and industrial structures. With few exceptions, foreign nations franchise or own outright the single provider of telecommunications facilities and services whose service obligations parallel our "common carrier" classification. This Post Telephone and Telegraph ("PTT") model institutionalizes government intervention in the marketplace, often replacing market-based resource allocation with social engineering, e.g., charging supracompetitive rates for services used by businesses, presumably with deep pockets, as a source of revenues to subsidize below-cost rates for other types of favored telecommunications offerings, e.g., residential, "Plain Old Telephone Service" ("POTS"), or postal service. End users often have little say in how the PTT operates.

Nations applying the PTT model reject the notion of private carriage, and have only begun to consider the merits of limited competition. The presence of private carriers, who by definition have no absolute service obligation, presumably threaten the PTT monopoly even though they presumably will serve specialized markets, [2] rather than merely skim the cream off common carriers' most attractive markets. Nonetheless, many foreign governments fear user migration to less remunerative services and a loss of control over the total set of services available.

Foreign opposition notwithstanding, users increasingly demand specialized and sophisticated new offerings. A degree of consumer sovereignty, and the imperatives of a global economy, efficiency and growing support for "privitization," where government relinquishes its ownership of the PTT, support greater flexibility in the provisioning of international telecommunications facilities and services. At the very least ,the PTT now faces greater pressure to adopt a more businesslike approach.

This paper will evaluate he FCC's private carrier concept from a user perspective and determine whether this domestic program can achieve international acceptance. Absent a parallel private carrier industry overseas, a number of ways to integrate U.S. private international carriers will be considered.

I. Domestic Private Carriage and Competition

For over twenty years, the U.S. government has grown to rely on technological innovation and market maturity to support relaxed regulation. The Commission's Above 890 decision [3] first recognized that a new technology, microwave transmission, could support a departure from the conventional view that telecommunications services were natural monopolies, available only from telephone company common carriers. The Commission authorized the establishment of private, non-common carrier, microwave telecommunications networks, thereby affording businesses the option to erect their own systems, with greater privacy, security, and cost savings than available from conventional carriers.

The Commission soon augmented the private network option with a new class of specialized carriers who, while considered common carriers, could limit the scope and nature of services they chose to offer. [4] By the middle 1970's, the FCC had established the premise that common carriers had no absolute entitlement to a captive customer base, and furthermore, that specialized, common carriers, and private, non-common carriers could serve niche markets, including those that required interconnection to the public switched networks of the local telephone company. [5].

The Commission developed the private carrier option as a vehicle to promote service diversity and price competition achieved in part, by enterprises unlikely to enter the marketplace absent their non-common carrier status. Private carriers do not hold themselves out to the general public, instead opting to deal on an individualized basis through medium to long term contracts. By nature of their recent market entry, and the intent not to be "all things to all people," private carriers lack market power, the ability to control the price or supply of essential telecommunications facilities or services, and therefore require less regulatory oversight. Such enterprises do not have to file tariffs, whose terms and conditions would apply indiscriminately to all similarly situated consumers. Instead, they can "tailor . . . offering[s] to meet specific customer needs, to provide customers with an alternative to existing carrier services

. . . . " [6]

The judiciary has affirmed the FCC's decision to augment the traditional common carrier classification, with the less regulated private carrier classification for such services as specialized mobile radio, non-video distribution services by cable television systems, satellite common carriers who elect to sell part of their capacity on a individualized basis, and fiber optic cable systems used to transmit a variety of voice and data services.

II. How Compatible is International Telecommunications and Private Carriage?

PTT reticence to work with U.S. private international carriers ("PICs") operating outside the traditional common carrier mold, reflects the impact of conventional international common carrier ownership and service commitments. PTTs expect to match "half-circuits" with "foreign correspondents" at the theoretical mid point of a route between nations. This correspondent relationship, memorialized in a specialized contract called an operating agreement, is predicated on long standing cooperation and coordination. The PTT expects its U.S. counterpart, to comply with the mandatory Regulations, and the optional but regularly followed Recommendations of the International Telecommunications Union ("ITU"), the specialized agency of the United Nations that sets technical and operational standards for world telecommunications

While the FCC views with optimism the prospects for PICs, the Commission has neglected to consider the likelihood that PTTs will grant operating agreements, or whether even commercially attractive arrangements might not occur because of countervailing political, industrial policy or philosophical factors. Likewise, the Commission has not fully addressed whether and how PTTs will respond to the more direct contact and involvement many sophisticated PIC customers may seek when attempting to have their specialized service requirements met.

A. What the FCC Has Done to Promote Facilities-based PICs

The FCC's 1985 decisions promoting the concept of satellite systems separate from INTELSAT, [7] and private submarine cable systems not part of the conventional common carrier consortia, [8] created the potential for extending the once, domestic-only concept of private carriage. However, these unilateral U.S. policy edicts, and corresponding conditional authorizations of individual carriers, [9] have yet to achieve a significant impact on the manner by which international telecommunications capacity is accessed, or the scope of user options.

Merely authorizing new facility options does not guarantee successful market entry, particularly when the international telecommunications marketplace has to accommodate treaty obligations and vaguer notions of foreign relations. By expressly requiring U.S. satellite PICs to secure at least one foreign operating agreement prior to final authorization, and refraining from assessing whether U.S. cable PICs enjoyed parity of market access, the Commission chose to emphasize national obligations, perhaps to the detriment of national rights to expect or demand fair treatment and the same degree of market access as would occur in the U.S. for foreign private carriers.

Rather than concentrate on the concerns of PTTs over the impact of cable PICs, the FCC arguably is required by law to ensure parity of access prior to permitting U.S. landfalls by cables linked to foreign locales and partially owned by foreign entities. The Commission grants cable PIC applications pursuant to the 1927 Submarine Cable Landing License Act, 47 U.S.C. Secs. 34-39 that contains provisions designed to achieve reciprocal treatment of U.S. interests abroad. Section 35 authorizes the President to "withhold or revoke such license when he shall be satisfied after due notice and hearing that such action will assist in securing rights for the landing or operation of cables [with U.S. ownership interests] in foreign countries, or in maintaining the rights or interests of the United States or of its citizens in foreign countries, or will promote the security of the United States, or may grant such license upon such terms as shall be necessary to assure just and reasonable rates and service in the operation and use of cables so licensed." Sec. 308(c) of the Communications Act of 1934, as amended, authorizes the FCC to impose "any terms, conditions or restrictions authorized to be imposed with respect to submarine-cable licenses by Section 2 of [the Submarine Cable Landing License Act]."

However, the Commission views cable PIC capacity as "a supplement to, and not a substitute for, common carrier capacity." Hence, such cable PICs are "not [to] be considered as part of . . . [FCC] proceeding [which considers traffic requirements for common carier capacity] or within the NACP [the North Atlantic Consultative Process wherein foreign governments and carriers coordinate international cable demand projections and deployment of new capacity]." [11] Hence, it appears that the Commission is disinclined to raise trade policy and market access questions when it thinks market "niche" players are involved.

The Commission recently did consider the degree to which it could impose information reporting requirements on U.S. and foreign carriers, perhaps with an eye toward assessing whether it should employ regulatory tools as leverage to foster parity in market access. [12] Such efforts were dimly viewed throughout the Executive Branch prompting the Commission to abandon all but the requirement that dominant foreign carriers operating in the U.S. file quarterly reports on traffic and revenue. [13]

As to PIC cable and satellite systems, the Commission has imposed a number of additional conditions on PIC satellite and cable systems that impede their attractiveness to prospective users and limit their financial or operational value to prospective foreign correspondents. Mindful of this nation's treaty-level commitments to INTELSAT to avoid causing "significant" technical or economic harm, [14] the Executive Branch, through the Departments of Commerce and State, informed the FCC of licensing criteria necessary to safeguard INTELSAT's core switched revenues. [15] Separate satellite systems are restricted to the sale or long term lease of space segment that cannot access the public switched network at either end. While INTELSAT's internal calculation of cumulative traffic and revenue diversion from separate systems may reach a level considered by some PTT investors in INTELSAT as causing economic harm to the cooperative, the U.S. had affirmatively taken measures, not imposed by other nations on their separate systems, to foster a measure of competition without harming INTELSAT.

Notwithstanding such affirmative actions, the U.S. initiative faced nearly universal opposition and apprehension that a policy determined by the President to be "in the national interest" [16] was not in the interest of INTELSAT or its owners who constitute the vast majority of prospective foreign correspondents with U.S. satellite PICs. While even the prospect of satellite competition prompted INTELSAT to streamline, offer innovative new services and reduce prices, the political fallout stemming from vigorous opposition, and the feeling by many nations that the U.S. was forcing the issue of its procompetitive philosophy, had the net result of casting aspersions on the concept of satellite PICs, even though users had yet to decide whether or not to migrate to the new option.

Cable PICs do not have the duty to consult with INTELSAT, or the FCC-imposed service limitations imposed on satellite PICs. But, their capacity is considered outside the mainstream common carrier inventory, which eliminates their participation in regional planning forums, and the legitimacy that would be conferred from such participation. It appears that the FCC has refrained from taking affirmative steps that would bolster cable PIC legitimacy and attractiveness to PTTs. The Submarine Cable Landing License Act contains language that could be read as requiring the FCC to assess whether equivalent market access exists at the foreign side of a proposed private cable. Nevertheless, the Commission refrained from requiring absolute parity in terms of operating agreement grants for other U.S. carriers, private or otherwise, by the cable PIC's foreign partner. Arguably, the FCC could condition a submarine cable landing license upon the requirement that foreign carriers participating in such joint ventures confer operating agreements to any qualified U.S. PIC.

Absent vigorous advocacy by the Commission and the Executive Branch and dialogue with their foreign counterparts, U.S. procompetitive, market-entry policies may not reach their full potential to enhance user welfare. After four years, a single separate satellite system has survived the maze of FCC authorization, INTELSAT assessment of the potential for technical or economic harm, and the ritual of courting prospective foreign correspondents. Alpha Lyracom Space Communications/Pan American Satellite ("PanAmSat") may soon reach a critical mass, having launched their single satellite into orbit in 1988, and having secured operational authority in several nations.including the United Kingdom, Federal Republic of Germany and Sweden. In middle 1989, the first private fiber optic submarine cable, operated by Private Trans-Atlantic Telecommunications System ("PSI") and Cable and Wireless, Ltd. of the United Kingdom will enter the growing North Atlantic telecommunications market.

The relative success of PanAmSat and PSI, and the paucity of other ventures likely to succeed in the future offer little proof that carriers outside the conventional mold will achieve full international market entry, or that newcomers are apt to destroy either the coziness or utility of the current industrial structure. PSI, and a proposed "private" North Pacific Cable, involve a United Kingdom common carrier, whose parent holding company has ownership interests in telephone companies throughout the former British Empire. Orion Satellite Corp., a potential separate satellite system, owes much of its staying power to its partner British Aerospace.

Even if one dismisses as unduly provocative and untrue allegations of PTT-boycotts, the pace at which the U.S. initiative has achieved international support, belie the Commission's conclusions that numerous of what marketplace and user benefits will accrue. Simply put, either the Commission has been overly optimistic, in the face of actual PTT indifference or opposition to the PIC concept, or merely authorizing a new class of carrier, without an advocacy campaign will not ensure international acceptance.

B. The Lesson From A Frustrated International Resale Rulemaking

The FCC's 1980 Notice of Proposed Rulemaking into international resale policy, [34] and the pace at which the Commission has acted to promulgate final rules is telling. With apparent confidence and conviction, the Commission strongly implied its desire to see its domestic policy on resale and shared use [17] extend internationally. The Commission authorized domestic arbitrageurs to procure bulk capacity designed for large users and resell the capacity in smaller units to users who singularly would not have qualified for the discounts. The Commission viewed resale as a potent weapon against the ability of carriers to discriminate in price on the basis of consumer volume requirements. Resellers can create pressure on underlying carriers to price services on the basis of relative costs, an outcome PTTs would oppose given the desire, and perhaps need, to exploit user elasticities and find sources for cross-subsidization of certain preferred service classes.

Rather than formally extend its resale policy in the face of PTT opposition, the Commission let its proceeding languish, relying instead on U.S. carriers to modify their tariffs implicitly to permit resale if and when they thought it would stimulate demand rather than migrate traffic from existing services. When AT&T modified tariffs to permit resale [18], no PTT complaint was heard even though vigorous opposition probably would have been voiced had the Commission formally acted.

Similarly, no significant PTT opposition exists when resellers "add value" to leased lines, and thereby become "Value Added Networks " ("VANs"). While the FCC requires all international resellers to seek authorization under Title II of the Communications Act and file tariffs, very little distinguishes these regulated carriers from unregulated, domestic private carriers and resellers. Perhaps the carrier classification enables the FCC to retain a necessary regulatory nexus, particularly where it might otherwise lack sufficient information on the makeup and nationality of the reseller. But perhaps also, the carrier classification confers a degree of legitimacy that enables resellers and VANs alike to secure the all essential foreign operating agreement, in their own right, or by bootstrapping the agreement of the common carrier providing the underlying transmission capacity.

The U.S. Government's reluctance to confront foreign opposition to resale perhaps evidences an unwillingness to advocate acceptance of PICs who cannot by themselves convince PTTs to confer operating agreements. Apparently, our national philosophical trust in marketplace resource allocation or some notion of "international comity" prompts both the FCC and the Executive Branch to abstain from imploring PTTs to accept U.S. PICs even when it is obvious that other non-economic factors affect the decision making process

C. Private International Satellite Links Provide a New Option

At first blush, the Commission's recent Declaratory Ruling permitting the licensing of private, non-common carrier international earth stations [19] evidences a new found robustness in advocacy for private networking. But on reflection, perhaps the expectation that such networks will access INTELSAT through the conventional retail distribution chain via COMSAT, the U.S. Signatory to INTELSAT, makes the proposal more palatable both to PTTs and the FCC.

The FCC issued a Declaratory Ruling deeming permissible a proposal by a foreign news gathering organization's U.S. affiliate for the option to apply for private, non-common carrier international transmit and receive earth station licenses. Rather than having to use the services of a "straw" common carrier who might do nothing more than handle the regulatory paperwork, the end user, provided it has limited its foreign ownership composition, can secure a license in its own right. And nothing forecloses the licensee from deploying such antennas throughout the U.S. for use by unrelated subscriber affiliates in a closed network configuration. Hence, it appears that a satellite PIC, operating on a resale basis, can rather easily achieve legal and operational arrangements, provided it does not go too far by:

> 1) constructing its own international transmission capacity, and thereby requiring the PTT to consider whether to interconnect with a new transmission pipeline; or
>
> 2) forcing the resale issue by offering a service that merely repackages existing carrier offerings like POTS, rather than adding value to a basic service, or stimulating usage of basic capacity by tailoring services to previously untapped market niches.

Successful operations by U.S. VANs and certain PIC networks who both lack the common carrier imprimatur, demonstrate that there are instances where foreign government regulatory administrations and PTTs will tolerate, or perhaps ignore, the dichotomy between U.S. PICs and their foreign common carrier correspondents. In some instances the U.S. PIC may voluntarily have applied for status as an ITU "Recognized Private Operating Agency," a classification that imputes carrier-like characteristics, but all PICs lack FCC common carrier certification under Title II of the Communications Act

D. U.S. Procompetitive Initiatives Fail to Pass Muster Internationally

The question whether to permit matching half-circuits and operating agreements with U.S. PICs juxtaposes the FCC's deregulatory campaign against most foreign governments' desire for a single full service PTT, perhaps augmented by a few, also regulated VANs. It is quite possible that PTTs will have a number of reservations about the concept of private carriage that may frustrate their market entry to an even greater extent than that experienced by recent conventional carrier market entrants. Set out below are a number of such concerns:

1) The PTT would have to consider whether to offer its users the same innovative, customer-tailored offerings, and the consequences of such diversity on its ability to price discriminate on the basis of user elasticities or other social criteria, e.g., making business users subsidize postal operations and residential telephony;

2) The PTT would have to determine the actual extent to which such private carriers will stimulate demand and generate new revenues as opposed to migrating traffic from preexisting services, even as PICs impose additional operational and transaction costs;

3) Neighboring or like-minded PTTs regularly collaborate ostensibly for planning purposes, but perhaps also with an eye toward achieving a single coalition with the best possible bargaining strength, vis a vis other carriers. Maintaining the "club's" shared views would be more difficult if carriers with different characteristics and service objectives proliferated;

4) The PTT model contemplates a single, government-owned or franchised facility and service provider who shall be "all things to all people." Given the close coordination required, PTTs would prefer their foreign correspondents to be similarly situated. As the PTTs diversify their array of offerings, e.g., to include information and valued added services, it may become increasingly difficult to find any U.S. counterpart with an equally broad "wingspan," but the preference would be to start with those carriers offering the broadest array, rather than deal with PICs who serve market niches;

5) The Regulations and Recommendations promulgated by the ITU contemplate a universe comprised of common carriers. Even ITU-approved "Special Arrangements," which enable nations to permit PICs, resellers and other exceptions to the status quo, are perceived by some nations as threatening the utility of standard procedures, as promulgated by the ITU. The ITU's recent World Administrative Telephone and Telegraph Conference ("WATTC") served as a forum for debate between nations supporting flexible regulation and accommodation of non-common carriers, and those nations inclined to subject any telecommunications carrier or information service provider to standard regulation;

6) The prospect for heightened competition, occasioned by FCC policies, may generate PTT apprehension, and the perceived need to invest in additional, perhaps unnecessary transmission capacity. Such capacity, even if unloaded at distressed prices, bolsters existing long term carrier alliances thereby building greater barriers to successful market entry by newcomers; and

7) Existing satellite cooperatives, e.g., INTELSAT, and common carrier consortia, e.g. the Trans-Atlantic Telecommunications cable owners, find it increasing prudent to create long-term lease options that work to stabilize demand, despite the prospect of new and perhaps cheaper options from PICs, e.g., private satellite systems, separate from INTELSAT, and private cable ventures, separate from the common carrier consortia.

III. A Campaign Strategy for Exporting the Private Carrier Concept

Empirical evidence generated over twenty years of declining domestic regulation confirms that private carriers can foster both inter-modal competition (satellite versus cable) and intra-modal competition (different classifications of service providers using the same transmission medium). Conventional common carriers may decry any degree of traffic migration, either to private user "bypass" systems, services of less regulated non-dominant carriers, [20] or unregulated private carriers. But no evidence exists that universal service has been jeopardized, or that conventional common carriers have suffered significant revenue diversions. Despite the confusion competition generates, recognizable financial and service benefits have accrued as private carriers primarily identify and serve market niches.

Within clearly articulated limits, PICs should have the opportunity to test whether they can achieve acceptance in the marketplace without dislocation to the PTT mission. The opportunity to serve does not constitute a guaranteed market share, or likely disruption to the status quo, particularly where bilateral agreements are required between carriers, and often between nations as well. Absent greater attention by the U.S. government to the degree of disparity in market access between the U.S. and many foreign nations, and a willingness to engage such nations in more robust dialogue, PICs will apparently be limited primarily to VANs and new earth station ownership options.

Set out below is a non-exhaustive outline of strategies that prospective PIC market entrants and their government advocates should consider using to achieve greater acceptance and closer parity in terms of market access:

Appeal to the PTT's and Government's Business Sense

Even the most bureaucratic and conservative PTT has managers concerned with expanding markets and exploiting technological innovations that increasingly distribute a degree of network access and control to end users. PICs can stimulate demand for existing services, and enable the PTT, or other sanctioned carriers, to enter the realm of information services. Newly industrialized countries like Singapore recognize the strategic importance of telecommunications to broad national industrial policy, and the ability to become a part of the integrated global economy. A PTT, which does not welcome new ventures and new services, may render that nation less attractive to foreign investment and less able to meet competitive challenges.

Encourage End Users to Become Advocates in Their Own Right

Large volume telecommunications users, and businesses that view telecommunications as a major strategic resource or cost center increasingly assess and compare national telecommunications market climates. Such sophisticated users may "vote with their feet" and locate new facilities in nations with a flexible regulatory approach and cheaper telecommunications services. U.S. government telecommunications policy delegations should include individual users, or user group representatives who consider themselves unserved or underserved by the absence of PIC options.

The recent proliferation of video programming distribution options throughout Europe attests to the power of consumer sovereignty. Foreign governments have to satisfy consumer demands despite concerns that diversity, private ownership and foreign participation in broadcasting and other technologies will jeopardize the ability of the government to serve social goals. Advocacy by prospective PICs and users they might serve can have a profound effect on the degree of interest the national PTT displays.

Eliminate The International Uniform Settlements Policy

The FCC policy that authorizes regulatory scrutiny over the accounting rates used by carriers to determine the division of international route revenues [21] may preclude newcomers from devising attractive financial incentives for PTTs to confer operating agreements. Rather than guard against the ability of a PTT to play one U.S. carrier against the other, i.e., "whipsawing," this policy may limit market entry only to those carriers who can convince PTTs that demand will be stimulated far in excess of increased PTT transaction costs. Often enough, newcomers must devise hidden financial incentives to the PTT, e.g., guaranteeing a certain traffic volume or the equivalent in revenue. Arguably, the services PICs would offer, even if leased by common carriers, do not constitute functional equivalents to existing common carrier offerings, making it inappropriate to subject them to existing accounting rates.

New PIC services would warrant accounting rate "protection" only if the potential for whipsawing exists. PTTs can whipsaw U.S. carriers only to the extent they must "buy" their way into a nation. Presumably, closer U.S. scrutiny to ensure parity of market access should obviate the need for U.S. PICs to make unremunerative traffic and revenue sharing offers simply as the price of market entry.

The U.S. Government Must Play a Greater Supporting Role as Advocate

U.S. telecommunications policy often lacks cohesiveness and continuity, a product perhaps of the fact that several agencies participate, each with its particular expertise and constituency, but none with the mandate and wherewithal for the primary leadership role. Rather than fight over turf, philosophical purity, or a least common denominator negotiating position, the FCC, Departments of Commerce and State, and U.S. Trade Representative, as primary agencies with telecommunications trade responsibilities, must complement each other. Similarly, they must recognize the need to pursue a common policy line that may take years to achieve foreign acceptance.

Inter-agency working groups and liaison with industry and users should enhance the government's ability to identify what is essential and what intelligent concessions can be made. Similarly, as the government expands its liaison function, it might be in a better position to determine how best to merge U.S. procompetitive philosophies with the growing parallel PTT interests in liberalization, privitization, expanded user options and enhanced network access.

U.S. PICs Should Seek Strategic Alliances with Foreign Manufacturers and Carriers

The adage that "half a loaf of bread is better than none at all" applies to telecommunications trade policy. Even as a PIC begins thinking what equipment to acquire, what services to offer, and what nations to target for service, it should consider alliances with foreign companies in a position to influence government and PTT policy. A U.S. satellite PIC who allies with a foreign satellite manufacturer is more apt to achieve market access in the manufacturer's national markets. Similarly, a U.S. venture interested in constructing a private international submarine cable is apt to secure foreign operating agreements if it opens the venture to a degree of foreign investment, and seeks the manufacturing, cable installation and maintenance service of foreign enterprises.

Use ISDN and Other Planning Forums to Support Multiple Carrier Access Options

The ITU's standards setting mechanism provides several forums for U.S.and other like-minded representatives to promote a telecommunications infrastructure that can accommodate different kinds of carriers. The Third Computer Inquiry's "Open Network Architecture" [22] and the European Community's "Open Network Provision" support multiple vendor access at least for enhanced services. Presumably it also fosters the kind of flexibility that would enable different types of carriers to compete. But the apparent willingness of the European Community to join with the U.S. in fostering technological and infrastructural flexibility to accommodate PICs contrasts in large part with the conclusions reached at the WATTC, and the course many CCITT study groups seem to be taking.

It appears that the majority of nations participating at the WATTC and other planning forums either oppose the notion of multiple carrier types, or at least prefer to make unconventional carrier options more difficult for nations to arrange. At virtually every instance where flexibility could be institutionalized to accommodate a multiple class of carrier and service providers, a broad coalition of nations "led by French-speaking Western African countries and joined by Spain, Greece, Italy, Iran and Iraq" [23] persuaded a clear majority of nations to reject the U.S. initiative supported to some degree by the United Kingdom, the Soviet Union, Japan, West Germany, Canada,the Netherlands and Nordic countries.

PTTs willing to make the substantial investment necessary to upgrade their telecommunications infrastructure to support Integrated Services Digital Networks [24] and other new services often perceive the need to secure a wide monopoly "wingspan" to recoup their investment and usher their participation in the "high tech" information age. Notwithstanding this, evidence supports the view that the availability of new services, either from PICs or resellers of PTT basic capacity, can stimulate demand and leave the PTT in a better financial position despite some loss of overall control.

U.S. emissaries to international planning and standard setting forums must recognize that these conferences increasingly have a substantial political and industrial policy component. A process once dedicated to promulgating standards to optimize technological and user utility now can be captured or distracted by efforts to promote "national heroes," and the technical standards and formats chosen by a particular manufacturer. This new aspect of the standard setting process requires analysis of nation's motivations, and the obligation to engage in vigorous dialogue with an eye toward promoting, wherever possible, flexibility and accommodation of divergent approaches to satisfying international telecommunications needs.

Conclusion

Twenty years of private carriage in the United States demonstrates that overall consumer welfare can be enhanced through new facility and service options without financial harm to conventional carriers. As with any proven domestic innovation, the incentive exists to "export" it internationally, despite the vast differences in market environments. PTTs are disinclined to support our policy initiatives where they take on a unilateral nature resulting from our government's failure to vet thoroughly the matter with foreign counterparts.

U.S. telecommunications policy advocates have an even greater threshold burden of persuasion with Private International Carriers. Foreign governments have legitimate questions whether the PIC concept threatens the PTTs' continued ability to subsidize favored services, and control the total array of facilities and service users can access. If the PIC concept is to reach the critical mass of international acceptance any time soon, non-facilities based resale of valued added services and other niche services will lead the way. Facilities-based PICs, like satellite systems separate from INTELSAT and private fiber optic cable systems force PTTs to assess whether new operating agreements will stimulate aggregate demand or foster traffic migration from facilities in which the PTT has an investment interest leading to a degree of "stranded investment." On the other hand, non-facilities based carriers, even though they raise the sensitive issue of resale, are increasingly viewed as legitimate new players who stimulate usage of the PTTs' basic telecommunications network.

The challenge presented by the PIC concept revolves around whether and how nations can agree on incremental steps to broaden the base of facilities and service options, despite the potential for loss of traffic and revenue stream control. Affording users new options, which has become the foundation for our procompetitive telecommunications policy, requires more review and deliberation elsewhere. Interested parties in the United States must walk a fine line between affording their foreign counterparts adequate time to consider the merits of our telecommunications policy initiatives, and aggressively pursuing dialogue to prevent inaction, further study, or outright rejection.

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[1] Private carriers do not indiscriminately provide communications services to the general public and have no legal compulsion to do so. See Nat'l. Assn. of Regl. Util. Comm'nrs. v. FCC, 525 F.2d 630 (D.C. Cir. 1976) cert., denied sub nom. Nat'l Assn.of Radiotelephone Sys.v. FCC, 425 U.S. 992 (1976).[hereinafter cited as NARUC-I]. "Factors that indicate non-common carrier operations include the existence of long-term contractual relationships, a high level of stability in the customer base, and individually tailored arrangements. LIGHTNET Sec. 214 Application to Construct a Fiber Optic System in Florida as Part of an Interstate Network, FCC 85-276, 58 Rad. Reg. 2d (P&F) 182, 185 (rel. May 20, 1985) citing NARUC-I at 643.

[2] See, e.g., Norlight Request for Declaratory Ruling, FCC 86-448, 2 FCC Rcd 132 (1987) aff'd, 2 FCC Rcd 5167 (1987) appeal pending sub nom. Pub. Serv. Comn. of Wisconsin v. FCC, No. 87-1618 (D.C. Cir. filed Oct. 12, 1988). As such, the system will have to be tailored to meet the . . . [private carrier's] particularized specifications, and users will have to operate in a fashion that will be compatible with these special features. . . . Norlight will not be in a position to hold itself out indiscriminately to the public." Id. at 135.

[3] Allocation of Frequencies in Bands Above 890 Mc., 27 FCC 359 (1959), mod. on recon., 29 FCC 825 (1960).

[4] Specialized Common Carrier Services, First Report and Order, 29 FCC 2d 870 , aff'd on recon. 31 FCC 2d 1106, aff'd sub nom. Washington Util. & Transp. Comm'n. v. FCC, 513 F.2d 1142 (9th Cir.), cert. denied 423 U.S. 836 (1975).

[5] See, e.g. Am. Tel & Tel. Co., Interconnection With Private Interstate Communications Systems (ARINC), 71 FCC 2d 1 (1979) (interconnection of local exchange common carrier private line facilities with a private interstate network).

[6] LIGHTNET, 58 Rad. Reg. (P&F) at 185, para. 7.

[7] Establishment of Satellite Systems Providing International Communications, CC Docket No. 84-1299, Report and Order, FCC 85-399, 101 FCC 2d 1046 (1985) [hereinafter cited as Separate System Policy].on recon., 61 Rad. Reg. 2d (P&F) 649 (1986), further recon., 1 FCC Rcd. 439 (1986).

[8] Tel-Optik, 100 FCC 2d 1033 (1985).

[9] See, e.g., Pan American Satellite Corp., 101 FCC 2d 1318 (1985), Orion Satellite Corp., Mem. Op., Order and Auth., File No. CSS-83-002, Mimeo No. 6871 (rel. Oct. 22, 1985).

[10] Inquiry into the Policies to Be Followed in the Authorization of Common Carrier Facilities to Meet North Atlantic Telecommunications Needs During the 1991-2000 Period, CC Docket No. 79-184, Report and Order at 9 (rel. June 24, 1988).

[11] Id.

[12] See Regulatory Policies and International Telecommunications, CC Docket No. 86-494, Notice of Inquiry and Proposed Rulemaking, FCC 86-563 (rel. Jan 30, 1987), Report and Order and Suppl. Notice of Inquiry, FCC 88-71 (rel. March 25, 1988), on recon. ___ FCC Rcd.___ (1988).

[13] See On Reconsideration, FCC Drops Requirement of Annual Core Equipment Procurement Reports by Major IX, Local Exchange Carriers; Dominant Foreign-Owned Carriers Still Must File Annual Traffic, Revenue Reports; Bureau Presents Study on Balance of Payments Deficit, 54 Telecom Reprts. No. 50, 6-9 (Dec. 19, 1988).

[14] Article XIV(d) of the Agreement Establishing the International Telecommunications Satellite Organization (INTELSAT), 23 UST 3813, TIAS No. 7532 (1973) requires the United States as a Party to this INTELSAT Agreement "to furnish all relevant information to and ...consult with the Assembly of Parties, through the Board of Governors, to ensure technical compatibility of . . . [separate satellite systems providing international public telecommunications services with INTELSAT's use] of the radio frequency spectrum and to avoid significant economic harm to the global system of INTELSAT."

[15] Having deferred action in separate system applications filed as early as March, 1983, at the joint request of the Departments of Commerce and State, so that the Executive Branch could review the impact of such applications on the national interest and foreign policy of the U.S., the Commission's Separate System Policy incorporated suggested conditions on actual authorizations expressed in correspondence dated November 28, 1984, from the Secretaries of Commerce and State to the Chairman and discussed in an Executive Branch White Paper. See Senior Interagency Group on International Communication and Information Policy, A White Paper on New International Satellite Systems (Feb. 1985) [hereinafter cited as Separate System White Paper].

[16] Presidential Determination No. 85-2 , 49 Fed. Reg. 46,987 (Nov. 30, 1984) attached as Appendix A in Separate System White Paper.

[17] Regulatory Policies Concerning Resale and Shared Use of Common Carrier International Communications Services, 77 FCC 2d 831 (1980).

[18] AT&T Tariff FCC No. 9, Sec. 2.2.3.A provides that "[t]he customer is advised that if the [leased channels] are used for third party use,

operating agreements independent of AT&T, must be made with the foreign administration, where required by such administration.... Without such arrangements, such use of the foreign administration's portion of the private line may be impermissible." RPOA Report and Order at 54, n. 130.

[19] Licensing Under Title III of the Communications Act of 1934, as amended, of Private Transmit/Receive Earth Stations Operating with the INTELSAT Global Communications Satellite System, Declaratory Ruling, FCC 88-92 (rel. March 15, 1988).

[20] See International Competitive Carrier Policies, Report and Order, 102 FCC 2d 812 (1985), recon. denied Mem. Op. and Order, FCC 86-339 (rel. Aug. 7, 1986).

[21] See Implementation and Scope of the Uniform Settlements Policy for Parallel International Routes, CC Docket No. 85-204, Notice of Proposed Rulemaking, FCC 85-332 (Rel. July 3, 1985), Report and Order, FCC 86-30 (rel. Jan. 30, 1986)[hereinafter USP Report and Order] on recon., 2 FCC Rcd. 1118 (1987). The Commission asserts that it does "have the authority to apply the USP to international enhanced services, but that such application need not (and should not) be undertaken at present." USP Report and Order 30, para. 37. Hence, the Commission can apply the USP on non-carrier companies, even if its currently declines to do so.

[22] For a description of the Third Computer Inquiry and Open Network Architecture see, Frieden, The Third Computer Inquiry: A Deregulatory Dilemma, 38 Fed.Com. L. J. 383-410 (1987), Wiley and Polsky, Understanding the Computer III Inquiry, 2 Telematics No. 10 (Nov., 1985).

[23] U.S. Delegation Head Expresses 'Serious and Fundamental Concerns' Over Final Results of WATTC; U.S. Signs But Takes 'Several' Reservations; Three-Part Article 1.7 Adopted, 54 Telecom. Reprts No. 49 at 41-42 (December 12, 1988). The Chairman of the U.S. Delegation expressed concerns that: 1) the Regulations formulated by the WATTC could be viewed as undesirably expanding the scope of regulation of services; 2) these Regulations also could unduly bolster the status of ITU Recommendations; and 3) they might have the outcome of restricting the discretion of ITU member nations to conclude Special Arrangements as permitted by Article 31 of the ITU Convention.

[24] For a discussion on the policy ramifications of ISDN see Siff, ISDNs: Shaping the New Networks That Might Reshape FCC Policies, 37 Fed L. J. 171-203 (1985); Frieden, Making ISDN Work: Practical Policy Considerations, 3 Telematics, No. 2 9-13 (Feb., 1986).

Session 2.4

The Information Revolution in the Pacific Rim: Implications for the 90's.

Chair: Paul Silverman, Booz Allen & Hamilton

Panel: Richard A. Atkins, McMillian Inc.
Patrick Greenish, Federal Express
Michael Ford, British Telecom International

NOTES

Session 2.5

Regulatory Issues

NOTES

ISDN
"WHAT IT IS AND WHAT IT IS NOT"

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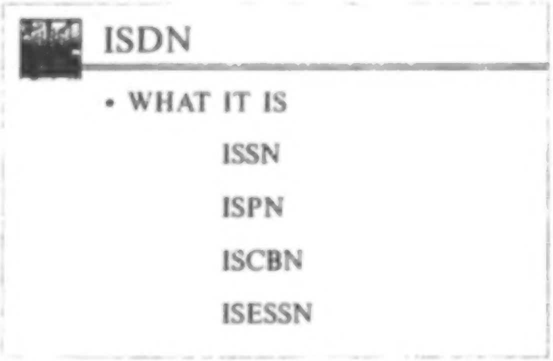
This paper will address some of the critical, non-technical issues surrounding the Integrated Services Digital Network (ISDN). It will also focus on some areas that could become problematic and are only now attracting long overdue attention.

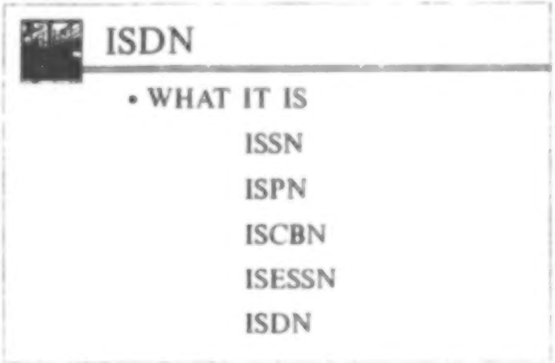
What is ISDN?

One way to define ISDN is to reflect on prior network technologies and their relationships to ISDN. Chart 1 provides the broadest definition of ISDN as perceived by NYNEX. These initials stand for Integrated Services Stepper Network, Integrated Services Panel Network, Integrated Services Cross Bar Network and Integrated Services ESS Network. ISDN is the next logical evolution of the telecommunications network. Each of these prior networks have provided "integrated services" within their own level of technology. ISDN (Chart 2) is simply the next one. It is different however from the prior technologies in substantial ways.


ISDN

- WHAT IT IS
  - ISSN
  - ISPN
  - ISCBN
  - ISESSN

CHART 1


ISDN

- WHAT IT IS
  - ISSN
  - ISPN
  - ISCBN
  - ISESSN
  - ISDN

CHART 2

First, the speed of the technology change is significantly greater. This will impact how regulators deal with such things as depreciation and deployment costs, how telephone companies handle the operational impact, and how quickly customers can recognize and take advantage of the new capabilities.

Secondly, ISDN is fundamentally different. The four prior networks functioned similarly as analog systems. Each of these prior network technologies would indicate an incoming call by transmitting a certain amount of DC voltage down a pair of copper wires to ring a telephone bell. ISDN will no longer send voltage down a pair of wires. It will be transmitting X.25 packet messages over the same pair of wires to an intelligent station. The intelligence in that station will decide what to do when it receives the packet and it may not ring the telephone.

This and other fundamental differences plus their operational impact are substantial and need to be reflected in our planning. From a telephone company perspective, the greatest impact appears to be the operational effects on our ability to provide quality service. Digitalization and packet transmission require a basic change in the delivery of all services. Delivering major volumes of quality ISDN service mandates extensive training and operational systems support. These do not exist yet in major form, and therefore stand in the way of delivering substantial quantities of high quality, operationally-supported ISDN.

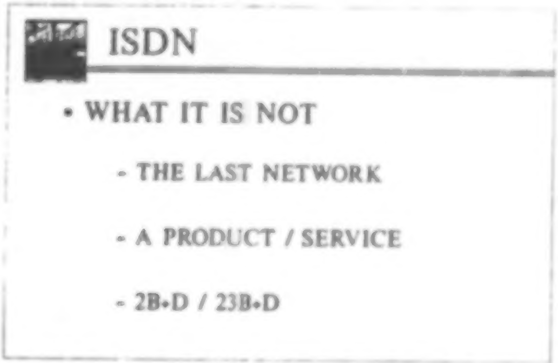
A third major difference from prior technologies is the impact the market will have on the deployment of ISDN. Previous network technologies were introduced in a tightly controlled monopoly environment. Telephone companies had the luxury of controlling the timing, quantity and degrees of deployment. Today's aggressive competition from a myriad of quality suppliers precludes that luxury. (This issue is addressed later under telco benefits of ISDN.)

Another major difference is the impact customer premises equipment (CPE) will have on ISDN network services. Prior network technologies were not constrained by concerns over the connectivity and functionality of the equipment used by the customer to enter, transmit over, and exit the network. The absence of true standards, not only for the CPE but the switches they connect to, will severely limit the customer value and slow the deployment pace of ISDN.

Lastly, ISDN affects the loop plant in ways much more dramatic than prior technologies. Such things as bridge taps, outside plant forecasting and distance limitations will play a greater role than in the past.

What ISDN is not (Chart 3)

First, it is not a product or a service. It is a network technology and architecture containing certain capabilities from which products and services will be provided where customer applications exist.



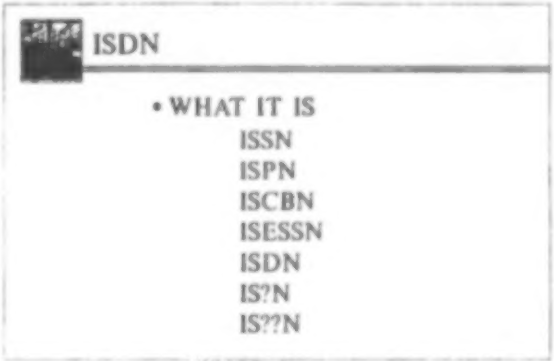
ISDN

- WHAT IT IS NOT
  - THE LAST NETWORK
  - A PRODUCT / SERVICE
  - 2B+D / 23B+D

CHART 3

Second, it is not 2B+D and it is not 23B+D. These are letters and numbers development engineers have arbitrarily assigned to the physical capacities of the different kinds of ISDN pipes. 2B+D and 23B+D are not products or services, and most providers will not offer them as such. This does not mean that telephone companies will not offer the full range of ISDN capabilities. Of course we will. These capabilities will be offered in the form of products and services with customer-oriented service names as we have in the past. With the introduction of the ESS Network Architecture, telephone companies did not introduce an ESS Line. We introduced Call Waiting Service, Call Forwarding Service, Touch Tone Calling Service. ISDN is no different in that respect.

Third, ISDN is not the last network. It is only the latest. There will be others. It may be Integrated Services Infrared Network, Integrated Services Bubble Memory Network, Integrated Service Magnetic Network, Integrated Services Super Conductivity Network, etc. (chart 4). It is not now known what the next network will be; but there will be one. And it will evolve from ISDN as we currently define it. ISDN is only the most recent network.



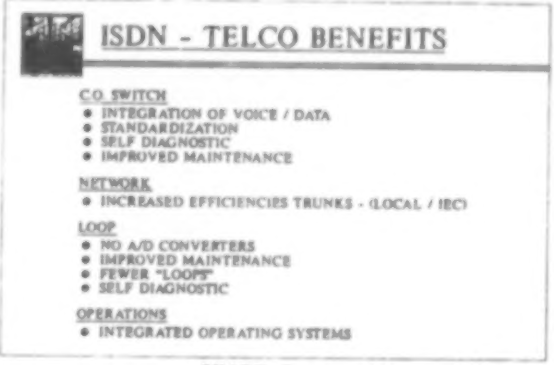
ISDN

- WHAT IT IS
  - ISSN
  - ISPN
  - ISCBN
  - ISESSN
  - ISDN
  - IS?N
  - IS??N

CHART 4

Telephone Company Motivation (Chart 5)

Let's examine briefly why a telephone company would convert its network to ISDN. First, by integrating voice and data services and standardizing protocols in the central office, telcos can increase their switch fabric efficiency and save money. ISDN is advertised to be more self-diagnostic, improving maintenance, and further reducing costs. In addition, telcos gain increased efficiencies in both our local and interexchange carrier trunk networks. Again more cost savings.



ISDN - TELCO BENEFITS

CO SWITCH
- INTEGRATION OF VOICE / DATA
- STANDARDIZATION
- SELF DIAGNOSTIC
- IMPROVED MAINTENANCE

NETWORK
- INCREASED EFFICIENCIES TRUNKS - (LOCAL / IEC)

LOOP
- NO A/D CONVERTERS
- IMPROVED MAINTENANCE
- FEWER "LOOPS"
- SELF DIAGNOSTIC

OPERATIONS
- INTEGRATED OPERATING SYSTEMS

CHART 5

The cost effect in the loop plant can also motivate a telco to deploy ISDN. By moving digital capability out to the customers' premises in great quantities we:

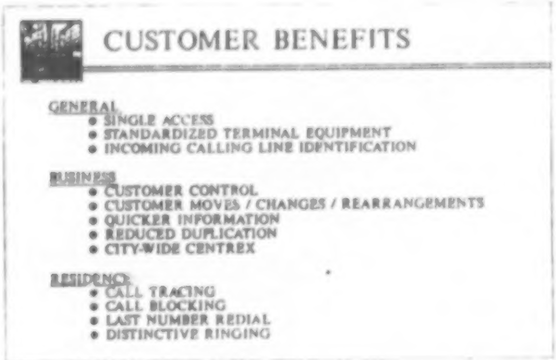
1. Eliminate the need for costly analog to digital converters;
2. Improve the maintenance on the loop by improving the self-diagnostic capabilities;
3. Reduce loop requirements because the very definition of "integration" means fewer loops.

Operational cost savings, however, may be somewhat of a red herring. Telcos anticipate significant operational cost savings by integrating support systems with a single set of standards (if and when we get them.) These savings will be long-term as the network is fully deployed and the older technologies are eliminated. In the short term, there will be an increase in operating cost, as we adopt another technology into our existing systems.

These benefits in the switch, network, loop and operating systems are the same generic benefits that a telephone company hopes to gain, and has attempted to gain, with every succeeding change in network architecture. In that regard, ISDN is no different from other technology conversions that used economic impact as a catalyst for change.

Customer Motivation - General

Given the significant levels of misunderstanding about ISDN in the market place, what do customers currently perceive are the benefits of ISDN? The following chart (6) highlights some of the general benefits customers expect. Customers believe it will be single access. That of course, is true. They also believe ISDN means standardized terminal equipment. Lets hope so, since most of the benefits to the mass markets will not accrue unless there is, in fact, standardized terminal equipment.



CUSTOMER BENEFITS

GENERAL
- SINGLE ACCESS
- STANDARDIZED TERMINAL EQUIPMENT
- INCOMING CALLING LINE IDENTIFICATION

BUSINESS
- CUSTOMER CONTROL
- CUSTOMER MOVES / CHANGES / REARRANGEMENTS
- QUICKER INFORMATION
- REDUCED DUPLICATION
- CITY-WIDE CENTREX

RESIDENCE
- CALL TRACING
- CALL BLOCKING
- LAST NUMBER REDIAL
- DISTINCTIVE RINGING

CHART 6

Customers also believe ISDN means Incoming Call Line Identification. That of course, is not true. Incoming Call Line Identification is a function of Signaling System Seven (SS#7) and not ISDN. We can deploy SS#7 without deploying ISDN. However, we cannot fully utilize ISDN unless we have Signaling System Seven.

Business Customers

The business customer anticipates that ISDN will give him greater control. There exist significant levels of customer control today. However, they desire more. Business customers are interested in such things as more efficient moves, changes and rearrangements of their equipment, plus greater information about their own network and the telcos. Customers believe ISDN means quicker information. Circuit Switch 56Kbps capability is available today and going to 64Kbps may not be that significant an increase, but that's what the customer thinks. The market believes that ISDN will reduce duplication. This is still ill-defined. Customers also believe that ISDN means Citywide Centrex. Again this is not true. Citywide Centrex is defined as:

1. a single dialing plan for all extensions regardless of the location and Central Office where they are served;
2. centralized attendant service for all disparate locations;
3. the elimination of tielines and usage charges to call from station-to-station between locations.
4. centralized system management (i.e., Automated Route Selection and Simplified Message Detail Recording) capabilities.

Citywide Centrex is not related to ISDN. It's an SS#7 capability that can make all locations appear to be served from one central office, and does not require ISDN.

Residence Customers

Residence customers' knowledge about ISDN is extremely sparse. Those who have some knowledge believe it means such features as call trace, call blocking, last number redial and distinctive ringing. All of these are real features, but they do not all require ISDN.

These customer (General/Business/Residence) perceptions are driven almost entirely by the early hype of the industry, particularly the advertising of the switching and equipment vendors and some telcos. Some advertise certain capabilities as being ISDN-dependent because the C.O. switch generics that have these capabilities are defined as "ISDN" generics. Many of these features can be provided from the software of these central offices without an entire conversion of the central office and/or the network to ISDN. However, customers (primarily business) have been informed that to get these services they must have their telephone company supply ISDN. Why? So that we, the telcos, will buy the next level of generics and switches. Having customers request new products of a telco is, of course, not all bad, provided the telco is prepared to serve and the customer has been given all the facts.

These next diagrams are simple definitions of what is involved in the transition to ISDN. The first diagram (Chart 7) shows how the telephone company services its customers today (pre ISDN) with voice, data, packet, video, facsimile, signaling etc. Each capability, theoretically, is on its own pair of wires. Post-ISDN simply "integrates" those capabilities on the same pair of copper wires. Theoretically this could be done by a telco without customer involvement. This of course, waves a magic wand over some of the current technical and interface issues. As in past technology transitions, the telephone company could implement significant portions of ISDN and never tell the customer. If the aforementioned economic benefits to the telco are real and, we can save dollars by improving network performance, we should and will, deploy ISDN technology for our own good.

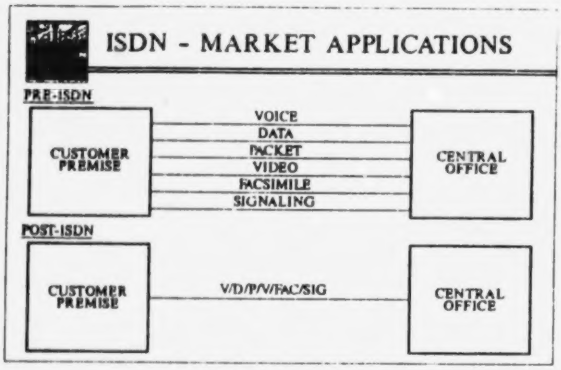

ISDN - MARKET APPLICATIONS
PRE-ISDN
CUSTOMER PREMISE
VOICE
DATA
PACKET
VIDEO
FACSIMILE
SIGNALING
CENTRAL OFFICE
POST-ISDN
CUSTOMER PREMISE
V/D/P/V/FAC/SIG
CENTRAL OFFICE

CHART 7

The second diagram (chart 8) shows each of these network access capabilities connected to different terminal equipment. If ISDN integrates and improves the efficiency of that access, customers can integrate and improve their operations. This technology has significant additional capabilities that can be offered to our customers to improve their business applications and satisfy their needs. That is where marketing must take the lead. We believe that marketing is the major missing piece of the ISDN puzzle. It seems apparent that ISDN progress has been impaired by an absence of proper marketing. ISDN movement into the marketplace requires detailed specific understanding of its impact on the customers' premises: what benefits can be gained by utilizing ISDN capabilities and how best to describe and offer those benefits to the customer. In the third diagram the "market impact" on the customer is consolidation from five employees to two.

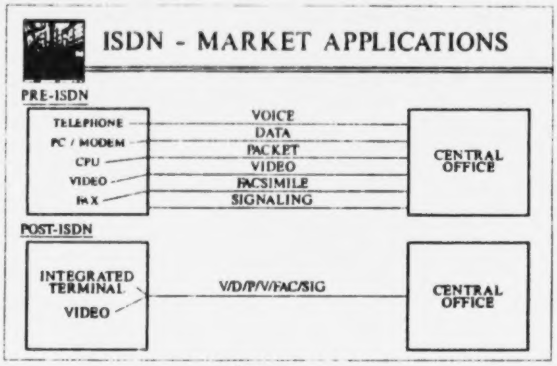

ISDN - MARKET APPLICATIONS
PRE-ISDN
TELEPHONE
PC / MODEM
CPU
VIDEO
FAX
VOICE
DATA
PACKET
VIDEO
FACSIMILE
SIGNALING
CENTRAL OFFICE
POST-ISDN
INTEGRATED TERMINAL
VIDEO
V/D/P/V/FAC/SIG
CENTRAL OFFICE

CHART 8

We should also understand that ISDN offers a significant number of new feature capabilities in the central office software itself that do not require integrated access between the C.O. and the customer premises (chart 9). These features have been classified as ISDN features by the switch vendors. This is not because they required ISDN technology at the customer premises (or in the loop in some cases), but because they are the next layer of features available in the generic software package that the switch vendor has classified as their "ISDN" package. It doesn't necessarily mean they are ISDN features.

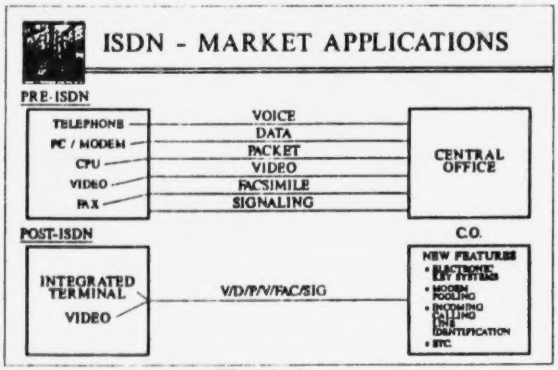

ISDN - MARKET APPLICATIONS
PRE-ISDN
TELEPHONE
PC / MODEM
CPU
VIDEO
FAX
VOICE
DATA
PACKET
VIDEO
FACSIMILE
SIGNALING
CENTRAL OFFICE
C.O.
POST-ISDN
INTEGRATED TERMINAL
VIDEO
V/D/P/V/FAC/SIG
NEW FEATURES
• ELECTRONIC KEY SYSTEMS
• MODEM POOLING
• INCOMING CALLING LINE IDENTIFICATION
• ETC.

CHART 9

MARKET OVERVIEW

The rest of this paper will address ISDN market applications, the market place as NYNEX perceives it, and our approach to it.

For about three years it has been possible to attend an ISDN conference somewhere in this country every week. The essence of the conferences always ended with the last chart, the last presenter, on the last day indicating that the key to ISDN were the market applications. What was missing, of course, were the specifics of those market applications: Did an ISDN capability satisfy an application need and what were the four P's of marketing (product, price, promotion and placement) surrounding those applications. Once the specifics of the applications can be identified and there is a match made with the ISDN technological capabilities, a product evolves (chart 10). Until the specifics of those applications could be identified (and they had not been), no true marketing work and no strong marketing catalyst existed to accelerate the deployment of ISDN.

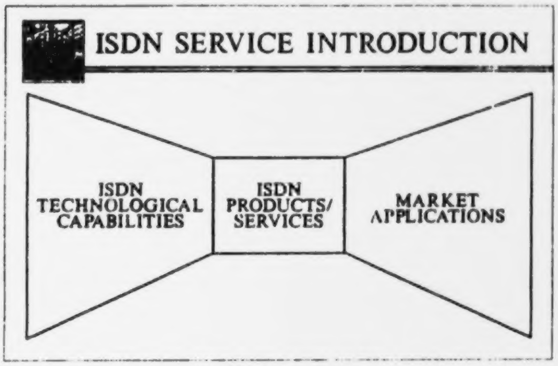


CHART 10

Most of the ISDN movement throughout the world and the U.S. has been technologically-driven. But it is generally recognized that until a significant market push exists, deployment will be slow. NYNEX believes we have now taken the steps necessary to address ISDN from that market perspective.

To identify market applications we must talk to the only experts in this field, the customers. This is best described by the position taken by John Cullinane, the chairman of Cullinet Software Incorporated: "We wanted to avoid a common mistake. We didn't want to develop software we thought customers should have rather than what customers wanted."

Of course, there has been significant research conducted by independent research firms, switch vendors, Bellcore and NYNEX. The results, however, were general in nature and concluded only that:

1. There was significant market interest;
2. There was significant market confusion;
3. Applications were the key, but nobody knew the details;
4. Customers perceived ISDN to be primarily a cost savings technology.

To get the details, NYNEX set out to understand four major areas in detail.

1. Key market segments;
2. Major customer applications;
3. Significant benefits, if any, of ISDN to our customer as defined by them;
4. Probable ISDN configurations.

From this research would come identification and quantification of the product, price, promotion and placement specifics. We needed to measure the responses by defining the specific voice and data services; the primary and secondary applications [wiring, conferencing, EDI, LANS, etc.]; when customers would opt for ISDN services; how many services by type would they opt for in those various time frames; what were the specific prices customers felt these applications would be worth and what were competitors charging today.

STRUCTURING THE STUDY

DEVELOP THE RESEARCH PROCESS

150 QUESTIONS TO:

1. DESCRIBE STRATEGIC BUSINESS APPLICATIONS
2. DESCRIBE CURRENT COMMUNICATIONS CONFIGURATION
3. DESCRIBE NEW SERVICE OFFERINGS
4. DESCRIBE CURRENT WORKPLACE ORGANIZATION
5. CONSTRUCT FUTURE COMMUNICATIONS NEEDS
6. COMPARE AND QUANTIFY BENEFITS
7. IDENTIFY AND ASSESS VENDORS
8. EVALUATE COST AND SELECTION FACTORS

CHART 11

We discussed these issues (see chart 11) in great detail, three hour interviews withover 110 firms and organizations. We conducted 80 one-on-one interviews with 170 individuals, 13 major focus groups and six individual case studies.

We talked to small, medium and large Centrex and PBX customers. It required over eight months and a half million dollars to complete.
The next chart (Chart 12) describes the only two reasons a customer will subscribe to ISDN Services.

1. If customers can reduce their overall operating cost with ISDN, they will buy. This does not mean that the customer will give NYNEX less revenue by subscribing to ISDN. It does mean that some cost of the customers business can be reduced by taking advantage of ISDN services.

2. A customer will subscribe to ISDN if the present level of operating business output can be improved. Operating business output can be defined as: customer service; revenue generation; perception in the market place; the need to be a technological leader or to keep up with competition.

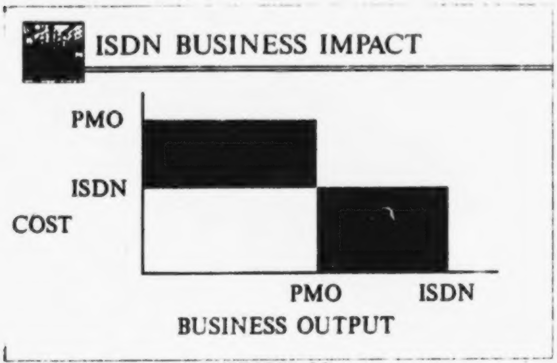


CHART 12

If a company believes it can improve its business position by subscribing to ISDN it will do so.

This chart (Chart 12) should be no surprise since it applies to any business decision. In that context ISDN is no different from any other service or capability a customer buys.

What ISDN is - Customer specific

The research indicates that over 70% of today's existing applications can be more than adequately served with digital voice and 9.6Kbps (1B+D) capability. This should not be surprising. It is a reflection of today's customer applications matching the capabilities (read limitations) of today's technology.

WHY?

1. Customers generally can't identify with capabilities they aren't familiar with.

2. Since we don't currently provide services beyond 1B+D capability in great quantities, customers had difficulty perceiving what to do with the second channel.

3. We are convinced, also, that the number of applications identified by our customers will greatly exceed, in quantity and timing the number of applications we in the industry will figure out for them. It is their business; they know it better than anybody else, and they will find out what to do with this technology well before we do. To generate a market push, we must show them that there are significant existing and new applications values for them. NYNEX now believes we can do that.

In approaching customers on the applications issues, it was important to start with an early understanding of why a customer uses communications and how communications decisions are made in today's environment. The general motivations are straight forward and not surprising that the first reason is so mundane, yet so important.

1. Minimizing wiring clutter and costs

2. Voice network management

3. Data network management

Motivation number three is rapidly taking over number two in Corporate importance and budget control.

DEFINING THE APPLICATIONS

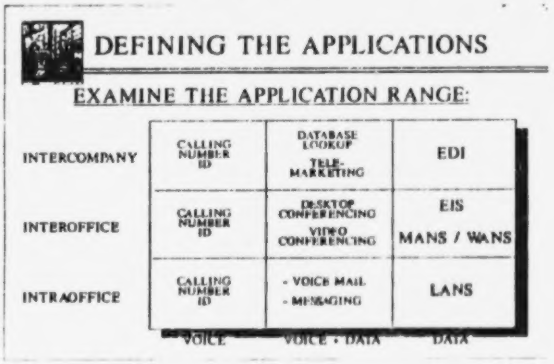
EXPLORING THE NEED AND USE OF 25 APPLICATIONS INCLUDING:

- EXECUTIVE INFORMATION SYSTEMS
- E-MAIL / VOICE MAIL
- DESKTOP CONFERENCING
- IMAGE MANAGEMENT
- RESERVATIONS
- TELEMARKETING
- ORDER ENTRY
- BULK DATA TRANSFER

CHART 13

The research initially anticipated a list of 47 potential applications. Customers recategorized and redefined these to a maximum of 25 with a heavy focus on 16 and finally eight primary applications (Chart 13). NYNEX will utilize these results to develop all 16 specific applications across the entire matrix as a means of motivating customers to take advantage of ISDN capabilities.

Applications benefits lead to cost reduction, job combination and redefinition, and/or revenue generation. Customer applications evolved to a matrix reflecting intercompany vs interoffice vs intraoffice spread across voice, voice and data or data only. (See Chart 14)



DEFINING THE APPLICATIONS

EXAMINE THE APPLICATION RANGE:

	VOICE	VOICE + DATA	DATA
INTERCOMPANY	CALLING NUMBER ID	DATABASE LOOKUP TELE-MARKETING	EDI
INTEROFFICE	CALLING NUMBER ID	DESKTOP CONFERENCING VIDEO CONFERENCING	EIS MANS / WANS
INTRAOFFICE	CALLING NUMBER ID	- VOICE MAIL - MESSAGING	LANS

CHART 14

NYNEX is in the process of designing applications binders that will deal with each application as we've identified it. Also included will be subsets of the application value by the various types of terminal equipment and hardware/software within each industry segment and how each segment chooses to satisfy that application need. These binders will be used by our negotiation teams to work with individual customers and help them take advantage of ISDN.

What is ISDN's Price?

The question of market price is very interesting. Price must be discussed in the context of capabilities and alternate solutions. It is common belief that large customers will drive the initial deployment of ISDN. NYNEX concurs in this but to a limited extent. Very few customers need to have every line in their corporation fully ISDN-capable. The selection of ISDN services will be driven by specific applications.

Due to their overall size, large customers are more likely to have some organizations that can gain a particular benefit from subscribing to ISDN capabilities. Therefore, those organizations should and will subscribe.

However, we suggest that the deployment of ISDN is applications driven and not line size driven. A mortgage clearing network of 30 to 40 people for a 10,000 line bank is no different than the applications benefit for a 30 station credit clearing bureau. The application is the same, the value and the benefit is the same, and therefore the sale should be the same.

Our initial approach assumed a grouping of ISDN services into packages and we attempted to have the customers help us define what product package configurations should be offered. This proved impossible. The ISDN solution will vary as a function of the customers' specific needs plus the fact that this technology, and the applications capabilities, cut across all market segments including residence, small, medium and large business, interexchange carriers and enhanced service providers. Using the above example, the bank's network may choose to use packet switching for its mortgage clearing applications, while the credit clearing bureau may choose to use circuit switching. Although the application is the same, the ISDN product solution will be different.

Also, ISDN network service revenues are largely dependent upon the availability of a multiplicity of standard terminal equipment, software, and hardware. Packaging of ISDN capabilities could severely limit the market's ability to take advantage of the specific capability required. We therefore, conclude it is inappropriate to package these services. NYNEX will use an approach that offers the greatest flexibility in choosing individual services. We believe this will:

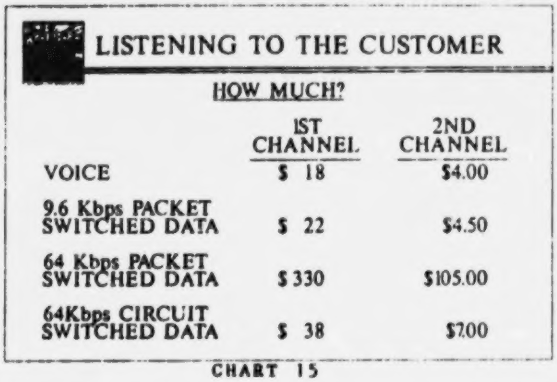
1. stimulate demand in the greatest quantities;
2. provide the greatest amount of flexibility for the myriad of applications and requirements, and
3. not force customers to buy packages that include services they may have no use for.

This menu approach to tariffing will offer all of the services in individual piece part components. This should provide the most flexibility and application benefits for the greatest number of customers (read market push).

Pricing

This next chart (Chart 15) is a summation of the approximate charges, or market price that customers have indicated they would be willing to pay for various ISDN capabilities. Prices must reflect the customer application, future needs, strategic business direction, and what they are spending today for alternate solutions.

These market prices do not relate to NYNEX's cost of providing the service. It is, however, our most critical number since it creates the "cost target" below which we must be able to provide these services. To be successful we must find ways to provide ISDN services in these ranges. This will be a significant challenge. Whatever the final price levels, they must also be offered in structures that provide significant levels of flexibility, such as contracts, volume discounts, and prepayments.



LISTENING TO THE CUSTOMER

HOW MUCH?

	1ST CHANNEL	2ND CHANNEL
VOICE	$ 18	$4.00
9.6 Kbps PACKET SWITCHED DATA	$ 22	$4.50
64 Kbps PACKET SWITCHED DATA	$ 330	$105.00
64Kbps CIRCUIT SWITCHED DATA	$ 38	$7.00

CHART 15

Quality

NYNEX is committed to the full deployment of ISDN technology wherever market demands can justify its economic deployment. Customers have sent a strong message that they will only subscribe to ISDN where they believe we can provide it in a quality fashion. That means that our operational support systems for outside plant, switching network traffic, customer negotiations, customer services data bases, billing, and repair will have to be reconfigured, deployed and operationally effective before these services are offered. NYNEX's long-term commitment to this new technology mandates a deliberate, organized and well-thought-out program. Five years ago we set ourselves the target of having a tariff available in the 1989 to 1990 time frame. We are still on that target.

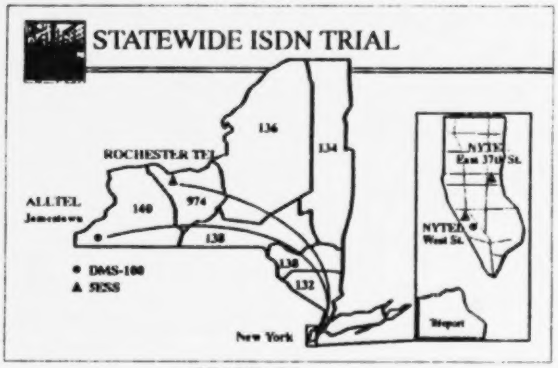
Regulatory

The regulatory issues surrounding ISDN in some sense are the same as those encountered in earlier network technological deployments. A strong competitive environment, however is compounding the problems of the past. Prior network technological deployment was based on the economic decisions of the telephone companies with stringent regulatory oversight. Without competition for these same services, telephone company management and regulators had tight control over construction budget decisions. Without competition, deployment decisions were based on economic benefits for the telephone company or physical plant exhaust. The timing of deployment is significantly altered now. Although the technology of the past will still provide functioning services today, its marketability is rapidly declining. ISDN is beginning to force regulators into more difficult depreciation decisions. Companies and regulators are also being forced into increasingly tougher choices.

In addition, regulators want to offer the greatest amount of technological capability to the broadest market base (i.e., residence) in the shortest amount of time, within the confines of economic efficiency. Trying to balance these less than consistent objectives is difficult. This desire is further compounded by the world marketplace. Telecommunications capabilities are growing rapidly. In addition to local economics in the short term, regulators must reflect on the long-term regional economics if a new technology is not deployed soon enough to assist in keeping business customers in their territories. Those customers have shown increasing tendencies to move to technologically advanced geographies within the U.S., the Pacific Rim or the European Common Market.

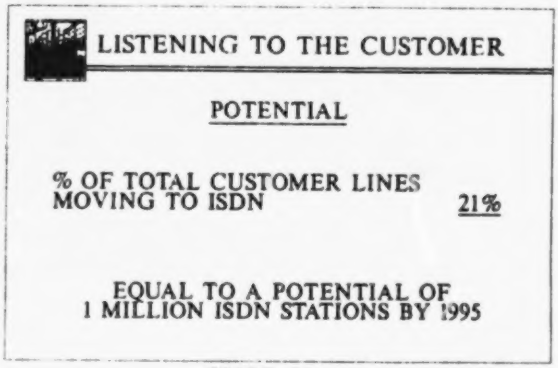
Recognizing this, the New York State Public Service Commission has ordered an ISDN Network trial involving local exchange companies and interexchange carriers. The purpose of this trial is to "bring together New York State telecommunications service providers to accelerate the technical evolution and actual deployment of the next generation of network services. This trial will also demonstrate across market segments, the continued strength of our telecommunications network by provisioning advanced network capabilities, including ISDN, to support a wide range of customer applications for the betterment of the public interest." [1]

The participants in this trial are New York Telephone (a NYNEX Company), AT&T Communications, MCI, AllTel of New York, Contel of New York, Rochester Telephone, and Teleport Communications. This is at least a two year effort. As opposed to "island" capabilities, this trial will demonstrate network capabilities and ISDN applications across lata boundaries involving a multi company/vendor network. (Chart 16) The end users will include some of our largest business customers as well as residence users.



STATEWIDE ISDN TRIAL

CHART 16



LISTENING TO THE CUSTOMER

POTENTIAL

% OF TOTAL CUSTOMER LINES MOVING TO ISDN 21%

EQUAL TO A POTENTIAL OF
1 MILLION ISDN STATIONS BY 1995

CHART 17

Conclusion

NYNEX has chosen to follow a slower, more deliberate approach to the deployment of ISDN than some other providers. Deployment of this technology can only be successful if driven by the marketplace -- its applications, its demands, how customers want it, where they want it, what they want to pay and when they want it. We are committed to this technology as an integral part of our network of the 90's and we will continue to offer only quality services. As mentioned earlier, this ISDN technology is a fundamental change in how we will deliver all services to our customers. The change is large enough to require a deliberate and conscious understanding of the impact on our customers and our ability to deliver quality service.

If NYNEX can follow what we've learned from our research and deliver the quality services our customers demand, we anticipate in excess of one million ISDN lines in service by the mid 1990's. (Chart 17). Maintaining a focus on what ISDN is and is not, will enhance our industry's ability to serve all of our markets.

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1 Final proposal submitted to the New York PSC by the Inter-Company ISDN Trial Task Force-May 18, 1989.

Value Added Services and the Liberal Regulatory Environment in the Federal Republic of Germany

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Abstract

On July 1st, 1989 a new telecommunications act has come into force restructuring the telecommunications market in Germany as well asthe Deutsche Bundespost itself. The German liberalization model relies on the dynamic force of competition and nevertheless takes into account that benefits can only be deriveds from this competition if an efficient and modern telecommunications infrastructure is provided. The model leads to a completely liberalized market for data communications and value added services. It is of great importance for the European Common Market starting in 1993.

1. Background

The reasons for the reform of the telecommunication markets which is initiated all over the world in all industrialised countries, are the rapid growth of the markets, the revolutionary technological development - let me just mention the transition from the analogue to the computer-controlled digital technology - the integration process of telecommunication, office communication and data processing, as well as the trend towards greater market orientation.

In view of this worldwide development of telecommunications we also recognised for the Federal Republic of Germany as a highly developed industrialised nation that it was necessary to start on restructuring the telecommunications market. For this reason a "Government Commission for Telecommunications" was set up as early as 1985 as an independent group of experts, which was composed of representatives from industry, the unions, sciences and political parties. After more than two years of research during which the situation of telecommunications in the Federal Republic of Germany was analysed and the international trends were reflected, the Commission's chairman Prof. Dr. Witte submitted the Commission's report and recommendations to the Federal Government in September 1987.

On the basis of these recommendations a concept for the organisation of posts and telecommunications in the Federal Republic of Germany was developed. Based on this concept the "Law concerning the structure of posts and telecommunications" was developed and adopted by parliament. It was enforced on July 1st, 1989 on is now in the process of realization.

2. Objectives

On the one hand, the main objectives of the reform are to reorganise the telecommunications market to introduce a greater degree of market economy, effectivity and flexibility by opening the market as widely as possible to competition. On the other hand, however, to provide the Deutsche Bundespost as network operator with the organisational basis allowing it to compete successfully in this market as an efficient competitor.

In Germany, the Federal Government is explicitly committed to the principle of a social market economy which depends on effective and dynamic competition. On the basis of our sound infrastructure the innovative potential of telecommunications can be tapped better and faster if the general conditions of dynamic competition are further improved.

In accordance with this policy, regulatory intervention in the telecommunications sector must therefore be avoided to the largest possible extent. However, for infrastructural reasons certain telecommunications sectors cannot be opened to unregulated competition at all or only to a limited extent. Nobody doubts that this is true of any industrialized country. Those remaining monopolies must be clearly defined as exceptions to the principle of entrepreneurial freedom, thus guaranteeing all market participants a certain planning and legal security.

For the implementation of these objectives the bill concerning the structure of posts and telecommunications was formulated.

This bill clearly defines the borderline between the monopoly area, the tasks of the Deutsche Bundespost and the competitive area. Let me describe briefly the main points of the bill.

3. Organisation

One very important cornerstone of the reform of our telecommunications system will be the separation of the regulatory from the entrepreneurial functions of the DBP. The Ministry of Posts and Telecommunications will be divested of its entrepreneurial functions. In so far the new Ministry and its staff will have the sole role of regulator in telecommunications.

For the entrepreneurial functions, three separate public enterprises with their own vertical oganizational structure will be established, namely DBP Postdienst, the DBP Postbank and DBP TELEKOM. Each of these enterprises will be run by its own board of managers under the control of a supervisory board. The three enterprises will however be legally and economically linked within the DBP.

4. Network operation and competition in fringe areas

The network monopoly of DBP TELEKOM is to be maintained in principle since this represents the special infrastructural obligations of DBP TELEKOM which have to be met in the field of telecommunications. Only a homogeneous network infrastructure open to everyone on the same conditions and which is constantly being improved in line with technical advance can ensure that all user groups and regions will also have fair opportunities in future to use state-of-the-art information and communication services.

Preserving the network monopoly does not imply that private initiative will be precluded in the network field Especially where new technological systems can complement the cable-based infrastructure of DBP TELEKOM without impairing Telekom`s exclusive responsibilities private activities are possible and desired.

According to the draft law private providers will have a legal right to be authorized to establish and operate satellite systems operated at low bit rates (i.e. bit rates of up to 15 kbit/s) without restriction, provided that radio engineering requirements are fulfilled. Satellite systems operated at higher bit rates will continue to be subject to a special licensing procedure under the control of the Federal Minister of Posts and Telecommunications. However, licences must be granted as long as there are no objections by the radio engineering services and no interference is expected with the telephone service which will be provided only by the DBP.

To promote innovation and stimulate the market in the Federal Republic of Germany, private providers will also be allowed in future to offer mobile services. The Federal Government has decided to take the necessary steps immediately to ensure that competition is introduced by 1989 in the fields of radiopaging services and local and regional private radiotelephone networks. These networks will also receive access to the public network.

Another provider will be licensed in addition to the Deutsche Bundespost for the planned Pan-European Digital Cellular Mobile Radio Communication network (mobile telephone network D) which is to be established by 1991/92. In addition to ensuring competitive conditions on the basis of equal opportunities, the Minister of Posts and Telecommunications will also work towards a geographically balanced development of this service.

5. Terminal equipment and type approval

Open competition is also envisaged in the terminal equipment supply market. TELEKOM may participate in supplying and maintaining all terminal equipment as it sees fit. To ensure the functioning of the telecommunications network and the proper provision of monopoly and mandatory services all terminal equipment - including that of Telekom - will be subject to type approval to be carried out by an organizationally independent entity under the authority of the Federal Minister of Posts and Telecommunications.

These provisions to be applied in the Federal Republic of Germany are fully in accord with the proposals in the Green Paper of the EC Commission and the introduction of the common internal market in 1992.

6. Service offerings and tariff policy

As regards the telecommunication services to be offered in future, it is planned that on principle all services can be provided by TELEKOM and by private providers, competing on the market. Private providers will be able to offer telecommunications services to third parties by leasing transmission circuits or other services from TELEKOM on conditions not affecting competition and connecting them to their own systems for switching, storing and processing information.

One exception, however, is the telephone service which will continue to be entirely subject to the TELEKOM monopoly. Private service offerings that aim mainly at directly transmitting the human voice will not therefore be allowed.

In this the new telecommunications policy approach is taking account of the following facts: Against the background of the Bundespost's infrastructural obligation to make its services available to all users, the telephone service is the most important means of telecommunication and should not therefore be opened to competition which might result in regional differences in the offering of this service.

The revenues from the telephone service are to provide DBP TELEKOM with the financial capacity necessary in particular for an innovative and nationwide expansion of the telecommunications networks. Furthermore, they are to compensate for additional costs and possible revenue losses arising from its infrastructural obligations.

We are of course well aware of the fact that the maintenance of the telephone service monopoly will cause increasing difficulties for TELEKOM. Just the introduction of ISDN is a problem because it is difficult technically to separate voice transmission from the transmission of other services. For some time we have therefore endeavoured to secure our revenue from the telephone service to finance the infrastructure and other tasks by other means than by the monopoly for speech communication. This new approach is called "cost structure-oriented tariffs in the telephone service".

As in almost other countries, the current telephone tariffs in the Federal Republic of Germany are also hardly geared to the actual cost incurred in the provision of this service. Particularly the changes in the cost structures of the last few years have for social policy reasons not been reflected in the prices in the Federal Republic of Germany. Calls over great distances are relatively expensive and are therefore most profitable, whereas calls within one region hardly cover the costs. It is therefore easy to guess that free competition in the telephone service would under these conditions have as a consequence that private providers would exclusively offer the lucrative long-distance connections between large business centres. Undercutting the prices charged by DBP TELEKOM in this sector would be no difficulty since a private operator is not under the financial obligation to create a uniform telecommunication infrastructure. TELEKOM, on the other hand, would lose the revenue basis for financing its infrastructure and the other tasks.

In view of the fact that, on the one hand, the monopoly has to be protected in order to preserve the financial strength of TELEKOM, given the telephone service tariff structure as it is today, but, on the other hand, that the practical application of this monopoly will cause increasing difficulties because of the forthcoming service integration, we have now started to ensure for the medium-term future the income of TELEKOM by introducing a new tariff structure. This measure is called "Tariff 90", and the objective is to adapt the telephone tariffs gradually to the actual cost structure. As a first step of this tariff reform the charges for long-distance calls will be reduced in 3 stages by about 45% every year on 1 April 1989, 1990 and 1991, while the charges for calls within the extended local area will increase by about 1/3. The result will be more even distribution of income from all telephone calls, and the risk of losses when the telephone service monopoly will - wholly or partially - be given up will be limited.

After having briefly described the reasons behind the necessity to preserve the telephone service monopoly let me now discuss the other telecommunication services. All these services are provided on a competitive basis and will in future fall into two categories: the so-called mandatory services and the unregulated services.

As regards the so-called mandatory services, these are as a rule telecommunication services which are internationally (EC, CEPT, CCITT) standardised or governed by international agreements or for which new networks are required. For such services the Federal Minister of Posts and Telecommunications will lay down obligations in agreement with the Minister of Economic Affairs, which may be different for the individual services. Conditions for mandatory services may concern the infrastructure (e.g. nationwide application of uniform tariffs, nationwide coverage or obligation to contract), or public welfare obligations (e.g. special tariffs for the socially underprivileged or other tariff policy requirements). Such obligations can only be imposed on DBP TELEKOM. For private providers of services which materially correspond to the mandatory services of DBP TELEKOM there will be no such obligations.

The mandatory service tariffs will be fixed by DBP TELEKOM, the Federal Minister of Posts and Telecommunications, however, may make an objection.

All the other services, i.e. all services which are not monopoly or mandatory services are **unregulated services**. TELEKOM is free to decide whether or not to participate in this unregulated competitive market. These services will in particular be application-oriented services (value-added services). The tariffs for the provision of unregulated services will be fixed by TELEKOM.

Transmission services except for satellite communication and mobile radio, and the telephone service will remain **monopoly services** to be provided by DBP TELEKOM. All the other services will be open to competition. These **competitive services** will be offered by private providers and DBP TELEKOM. In this competitive segment DBP Telecom will be obliged by special regulations to offer certain services, the so called **mandatory services.** The mandatory services and the associated infrastructural obligations will be issued by the Federal Government. Private providers will be able to offer the same or comparable services without these obligations or any special regulations. The class of the mandatory services is therefore mainly relevant to DBP TELEKOM.

As DBP TELEKOM will be active in monopoly as well as in competitive areas care must be taken that monopoly profits do not impair the competitive opportunities of other providers without any justifiable reason.

Apart from this, TELEKOM must continue to be able to cover its additional expenses in the field of mandatory services, which will necessarily result from the obligation to provide infrastructural services under competitive conditions, or corresponding losses in revenue by using surpluses gained in the monopoly sector.

Moreover, to keep its innovation capability DBP TELEKOM must also be able in future to finance new services provided in competitive sectors by using revenues from the monopoly services for a limited time during the introduction phase. In addition to supervising observance of the Law Against Restraints of Competition, the Federal Minister of Posts and Telecommunications will therefore have to perform special regulatory and controlling tasks in relation to the Deutsche Bundespost.

With the introduction of **mandatory services** and an appropriate control of the market behaviour of DBP TELEKOM our reform concept allows a reasonable balance between the infrastructural aspects and the principle of competition in the field of services. I know that it won't be easy for the Minister of Posts and Telecommunications to maintain this balance given the extreme dynamics of the telecommunications market.

With the definition of reserved and competitive services in its Green Paper the EC is following a similar balance between infrastructural and competitive areas, which is not less difficult to maintain. The Green Paper and our new telecommunications bill harmonize in all major regulatory aspects, most probably because both papers were elaborated almost at the same time and in the same technological and economic environment.

We are convinced that our common approach will serve all our customers best.
Not to mention that it is in DBP Telekom's own interest to look after its business customers - be they small or large companies. In our country too they contribute greatly to the revenue of the network operator. DBP-TELEKOM will therefore continue to increase its efforts to satisfy their needs. One essential factor in supporting this goal is tariff policy.

On the one hand, the tariffs and conditions of use of leased lines are of paramount importance in the development of service competition in the Federal Republic of Germany. On the other, they are not less important for the competitiveness of large companies since leased lines form the central nervous system of many large companies for whom timely information about the activities of all its distributed sites is a major prerequisite for success.

In its national service area the Deutsche Bundespost at present offers two types of leased lines:

- leased lines for data applications (they must not be used for speech communication), and

- leased lines for speech applications (they may also be used for other types of communication).

For dedicated data connections flat tariffs are charged.

Regarding dedicated speech connections (analogue or digital) flat tariffs are charged up to a usage duration of 80 hours per month. For the usage of leased lines beyond the local network area additional connection time-dependent charges apply for durations beyond 80 hours. The time-dependent charges are governed by the switched telephone network tariffs. They have been set, however, in such a way that the usage of leased lines is considerably more cost-effective than using the switched network.

In view of the already initiated reform of the switched telephone network tarffs (to bring them more in line with actual costs) and the forthcoming reform of the whole system of posts and telecommunications in the Federal Republic of Germany also the fixed connections tariffs have to be re-examined.

With its basic ideas of

- monopoly on network infrastructure

- competition in all services except telephone service and

- full competition on the terminal market

the FRG is closely in line with the green paper of the EC. We hope hat in the very near future these ideas will be the basis for the common market of telecommunications.

Caller Identification: The Two-Edged Sword

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ABSTRACT

A national survey of adults in US telephone households conducted in early 1989 explored attitudes and opinions related to the increasing collection and use of personal information. Restrictive orientations toward the development of mailing lists are seen to vary by gender, race, schooling and employment status. The greatest demand for Caller-ID services is associated with the desire to screen out direct marketing calls.

Introduction

Caller-identification, as part of the host of enhanced services made available with the introduction of narrow band ISDN capacity in inter-LATA service, represents an entry point through which to explore important questions of social policy. A national survey of adults in the continental United States provides the basis for an analysis of the complicated issues involved in the increased use of telecommunications for the coordination and rationalization of product and service market efforts. The often contradictory feelings people have about their privacy, and the ways in which the telephone can enhance or threaten it are explored in the context of differences associated with membership in particular social and economic groups.

Surveillance and Information Privacy

Several authors have referred to this emerging information age as a surveillance age, and information societies as surveillance societies (Flaherty, 1988; Marx, 1988). Information about workers, consumers and citizens has become increasingly necessary for the governance of societies of ever expanding complexity . Information is used to rationalize production, distribution and mass consumption (Beniger, 1986) in pursuit of greater efficiency. The rationale for the pursuit of efficiency in manufacturing is the same logic which guides the search for more efficient ways of targeting commercial appeals to potential clients or customers. And, it is the same rationale which leads the government to require sophisticated searches and matches of remote databases to facilitate screening so as to avoid "fraud, waste and abuse" in the delivery of government services (USOTA, 1986).

The collection and use of personal information as inputs into the machinery of social control (Wilson, 1988) have periodically generated public concern about threats to an individual's right to privacy (Linowes, 1989; Rubin, 1988). At the same time that technology and practice threatens to narrow the boundaries of one's "reasonable expectation of privacy" (Jussawalla and Cheah, 1987; Tomkovicz, 1985), public resistance erects challenges which enjoy varying degrees of success (Gandy, 1989). Privacy advocates have been active in indentifying the consequences for individual privacy which are inherent in these technologies and related practices (Berman and Goldman, 1989). Systems which facilitate the collection, storage and transmission of information about the citizen/consumer for use by data base marketers are the principal focus of concern. Computerized lists have become the lifeblood of the direct marketing industry, and the telephone network has become its most vital organ collecting, concentrating, and routing that information at high speed around the nation and the world. Devices which capture and display private information about consumers, and use that information to restrict or control their access to services are the subject of this paper.

Caller*ID and other ANI/CLASS Services

AT&T was the first of the long distance carriers to offer ISDN services which involved the delivery of calling party identification (Johnson, 1989). Their primary rate interface interface(PRI) technology facilitated the transmission of packetized data about calls. Automatic Number Identification (ANI) is one of AT&T's PRI services which forwards the 10-digit or billing number while the voice circuit is being established. The service is particularly useful for the telemarketing organizations with 800 numbers as the number identification can be used to retrieve a record of the customer's account before the call is actually completed (Brown, 1989).

According to one source (Johnson, 1989) "an inbound telemarketer can pull up a customer record based on a telephone number, personalize the greeting to the calling party and associate the calling number with an existing account record, such as ordering history" (p. 34). American Express has been an early, and a heavy user of AT&T's "INFO-2" service to reduce the time per call for its Travel Related Services, and its other telemarketing subsidiaries. Not only do such systems reduce the length and expense of telephone transactions, but they make it increasingly possible to eliminate the need for human operators entirely. Rule and Attewell (1989) describe the use of an automated system to discriminate between incoming calls to a taxi service.

"Previously, the approximately ten telephone operators/ dispatchers on duty would perform these discriminations themselves, answering each call and then deciding how rapidly to dispatch a cab. Now this process is computerized. The computer classified each incoming call according to its potential profitability; lowest priority calls from the general public and ascending priorities to corporate subscribers according to the fees they pay" (p. 237).

While the telephone dispatching system may produce its discriminatory allocation on the basis of records of past behavior, other systems may discriminate on the basis of broad profiles and probability estimates of expected revenue for each transaction. Such decisions might be based on information about which geodemographic cluster the incoming call originates from (Weiss, 1988). Thus caller identification services could facilitate remote, automated, electronic redlining of particular ethnic communities.

Innovative suppliers of information services will soon provide a broad range of caller information to add to the billing number passed by AT&T and other carriers. Although not available in real time, Infomedia Corporation provides "800 ID" services which provides "complete name and address, with up to 24 demographic characteristics about the caller" (Johnson, 1989, p. 35). In testimony before the Pennsylvania Public Utilities Commission, Gary Marx implied that approval of unrestricted Caller*ID service would make it possible for telephone companies to deliver even more information about customers to others willing to pay for it.

"Can and will phone companies sell information regarding consumer phone behavior without the consumer's consent or knowledge? Given the cornucopia of information and the economic advantages of pin-point and segmented marketing..., the temptation to sell such information be strong. Will consumers have any right to restrict such use once Caller*ID is approved?(May, 1989, p. 11).

While the initial offerings of ANI services were designed to meet the needs of business customers, New Jersey Bell, and was successful in overcoming objections of the New Jersey Public Advocate, and introduced a similar service for residential users. A limited survey of residential users found that 58% would like to receive the calling party's number, but 82% would not like to have their own numbers passed to the numbers they call. The contradictory position was explained as a concern that residential users felt a need for anonymity when they were calling about crimes and personal matters.

In 1988, Indiana Bell introduced experimental services in the Muncie area for both business and residential users. The Custom Local Area Signaling Services (CLASS) which were being introduced offered a host of options in addition to caller identification: 1) call screening would allow the customer to deny certain callers access to their number. This could be facilitated through a last call blocking, or on the basis of a directory of billing numbers from which the customer would not receive calls. 2) call trace, would output the number of the last call to an authorized agency prepared to handle harassing calls. This service would not involve informing the victim of the number of the phone from which the call was placed. 3) selective call forwarding would utilize a directory of predetermined numbers, and would forward calls from those numbers to another designated number. And, in addition to caller ID, 4) caller ID blocking would allow the customer to control the availability of their billing number.

Such services might be seen as having great potential to preserve the privacy of citizens who have sought the implementation of asterisk legislation to restrict unsolicited telephone calls (Nadel, 1986). The call screening and selective call forwarding features of the CLASS services would allow residential customers to block sales calls, even routing them to a dead letter office, or to a message that suggests that this home doesn't accept such calls. Katz (1988) reports that the majority of respondents in a national survey felt "that the privacy of the call recipient should take precedence over the desire of the caller to get through." The same technology would presumably allow customers to deny their home number when they call for 800 or 900 services. Of course, the availability of such a technology in the hands of residential consumers would represent a serious threat to the growing telemarketing industry.

Public Awareness and Orientation

Public policy formation is a complicated process, and one which is not well understood. Students of telecommunications policy have offered a variety of perspectives which take into account relative power to influence the debate (Gandy, 1982; Mosco, 1988, Noll, 1986). Public opinion is frequently a valued input in the policy process. Surveys not only guide the combatants in the development of their approaches to the grassroots, but they are also brought to bear as weapons in public hearings. Politicians as vote maximizers are hesitant to introduce or support legislation which appears likely to engender strong, vocal opposition from their constituents. Unfortunately, there has been very little research which has been published which speaks directly to the issues surrounding advanced telephone services. Many of the studies cited in public utility commission hearings are proprietary, and have frequently been criticized for their methodologies or on the basis of their samples. One widely reported survey reported statistics based on the responses of only 50 individuals. (Brown, 1989). Larger sample proprietary studies present summary data in ways that don't support secondary analysis, or the pursuit of the complex interactions between attitudes and measures of race and class.

This study seeks to inform the policy debate over Caller*ID and other emerging ISDN services through its insights into the social basis of differences in orientation towards information privacy.

Methodology

Between January 19th and February 10, 1989, a telephone survey was administered to a randomized sample of telephone households in the US. Phone numbers were generated through random digit dialing. After non-working, and business numbers were excluded from the sample, 3376 eligible numbers remained. Of these, 1749 refused to begin the interview, an additional 231 terminated during the interview, and 137 did not complee because of language difficulty. The 1,250 completed surveys are not fully representative of the US population in that there is not universal telephone service, and there are significant race, class, age, gender and regional differences in access to a telephone in the home. The final tabulated sample obtained was particularly over-representative of women in the population and the analyses that follow are based on a sample (N=981) weighted to correct for gender.

The survey asked asked several sets of questions presented in random order by professional telephone interviewers. These questions sought to determine what people knew about the ways in which their privacy might be invaded, how they felt about such invasions, and what kind of recourse they felt they had, or should have. Traditional demographic information was also gathered from each respondent. This paper will focus on a subset of questions related to telephones and data base marketing.

Findings

A factor analysis was performed on 24 attitude variables which were coded from 6-10, where six represented strong agreement, and ten represented strong disagreement with a statement. The solution identified eight factors accounting for 48% of the variance in these measures. On the basis of variables which loaded high on a single factor, we identified an "anti-list" factor which accounted for 5.3% of the measured variance. The three variables were: 1) There should be a way to keep your name off mailing lists (.64), 2) You have a right to have your name removed from any mailing list (.69), and 3) Companies should seek your permission before they tell any one else what products you buy (.53).

Analysis of variance was performed with the means of factor scores for groups identified by gender, race, education and work status. All reflected significant between group differences. The data suggest a clear class distinction, that is, income, education, and the work status of the primary wage earner, all of which are related to race, are clearly associated with views toward the activities of the list industry. In addition, women tend to express views which are closer to those of the well educated, independent entrepreneurs. These groups feel more strongly that the individual should maintain control over their transaction histories. These differences are evident even though the distribution of responses is highly skewed toward preserving an individual's control over personal information in lists.

TABLE ONE
ANALYSIS OF ANTI-LIST FACTOR MEANS

Gender(F=3.85, p<.05)
  Male=.064
  Female=-.062
Race (overall F=2.75, p<.01)
  White=-.052
  Black=.310
  Hispanic=.402
Schooling (F=5.78, p<.01)
  Low=.269
  Medium=-.003
  High=-.116
Workstatus (Overall F=5.55, p<.001)
  Self-employed=-.111
  Salaried=-.063
  Hourly=.052

Three additional questions tap respondent attitudes about the telephone and personal information: 1) Phone numbers called from my home are my business, and no one else's (PhoneMyBus), 2) It would be good to know who was calling before you answered the phone (WhoCalls), and 3)Someone should invent a telephone that would automatically screen out calls from people trying to sell you things (AutoScreen).

TABLE TWO
CORRELATION (PEARSON) MATRIX (N=970)
LIST-RELATED BELIEFS

	2	3	4	5	6
1) PhoneMyBus	.100	.105	.106	.08	.026
2) KeepNameOff		.207	.159	.087	.143
3) RemoveName			.123	.068	.052
4) SeekPerm				.077	.096
5) WhoCalls					.289
6) AutoScreen					

With N=970, r>.06, P<.05

We note that nearly all the variables are significant correlates of each other, with the exception of the most anti-sales measure (AutoScreen), and the measure of a claim of rights in called numbers (Phone MyBus). The strongest correlation (r=.289) is between the kinds of services which might be provided as part of a CLASS offering. Those who most want caller identification, would most prefer to use it to exclude unsolicited sales calls. This suggests that those most concerned about direct marketing calls, are less aware or concerned about the means through which they are added to a marketing database.

Respondents were asked several questions which sought to determine the ways in which they resisted invasions of their privacy. Some 31.7% reported having requested that their names be removed from a mailing list at some time in the past. Some 29.4% reported currently having, or having had an unlisted telephone number in the past, and 35.1 % report having refused to provide information on an application that they felt some organization had no right to ask. While only 72.9 % have ever been asked to participate in a public opinion survey in the past, 39% have refused at least once when asked.

With regard to legislative relief, respondents were asked to indicate the extent to which they felt there was a need for strong laws to control the sharing of personal information. Scales ranged from one (no need) to 10 (great need), and the following means and standard deviations indicate the relative importance placed on sources of shared data.

TABLE THREE

NEED FOR STRONG LAWS CONTROLLING THE SHARING
OF PERSONAL INFORMATION
MEAN(STANDARD DEVIATION)
REGARDING:

Credit cards	7.094(2.731)
Mailing lists	6.948(3.013)
Phone call records	6.899(3.044)
Consumer purchases	6.002(2.894)

Figure One provides a graphic representation of the relationships among attitudes, privacy conserving behaviors, and membership in groups which differ along age, class, and racial or ethnic lines. Hispanic or Black status are represented with dummy variables. Age is treated as a continuous variable, but represents membership in five cohorts (18-24; 25-34; 35-49; 50-65; 66+). The employment category of the primary wage earner (Work class) is treated as a continuous variable, but is composed of three cohorts based on the wage relationship, (hourly, salaried, self-employed) with the higher score representing a tradition of greater autonomy, or freedom from supervision or surveillance.

As the variables are coded, higher scores mean a stronger orientation toward the maintenance of information privacy. For the attitudinal variables, the lower scores reflect a stronger orientation toward the protection of privacy. Thus we find that the correlations with age are positive for laws, negative for resistance, and negative for attitudes. This may be interpreted in the following ways: Older groups are more supportive than younger groups of creating strong laws to control the use of personal information. At the same time, older groups are less likely to take action on their own, such as refusing surveys, having an unlisted phone, or providing false information. Age is the best correlate of the desire for a device which would screen out unsolicited sales calls, with older respondents desiring it more than younger ones.

This analysis suggests that work status is not a very reliable index of privacy orientation. However, to the extent that controls for education and income are effective, this measure of class suggests that greater autonomy at work is associated with a greater perceived need for legal restrictions, a greater desire for control of lists, and a rejection of telephone systems which involve identification of the calling party. At the same time, this relative autonomy appears to be related to an acceptance of business discretion to share purchase information.

Being Hispanic is the best predictor of whether a person has, or has had an unlisted number, at the same time it also suggests that Hispanics are less aggressive in asking to have their names removed from mailing lists, or in believing that there even needs to be a way to keep their name off mailing lists. At the same time, being Hispanic is the best predictor of the desire to have a device which would identify the calling party, and for Hispanics, that desire is apparently not to screen out unsolicited sales calls. One suggestion which has been offered suggests that the range of Hispanic names is such that wrong numbers are a serious problem for telephone households. A device which would let them know it was a wrong number would be quite valuable to these consumers.

Discussion

Of course, these data are only useful in providing very general impressions of those public attitudes toward telecommunications and privacy which have implications for the ways new services such as Caller*ID may be introduced. Race, gender, education, income, and work-related autonomy all have implications for how individuals may act to preserve their privacy. The data suggest that different groups have quite different reasons for being concerned about the use of personal information. These reasons may also be reflected in their preference for legal rather than technological protections of their privacy.

The variety in operational definitions of privacy argue strongly against any simplistic blanket restrictions against new telephone systems and services. Regulations which restrict abuses which injure some segments of the population, may at the same time, subject other segments to abuses of yet another kind which might have been avoidable were it not for these particular regulations. With regard to proposals which would limit the use of ANI technology, Toth (1989) notes that "mandating total ANI suppression is technically infeasible and would only create a false sense of security. It would do nothing to establish a legally recognizable right to anonymity as long as other methods for delivering the calling party's number continue unabated" (p. 39).

Toth's view is shared by Katz (1988) who argues that many other players will be seeking access to information about calling behavior, and that the FCC and other regulatory bodies will be under increasing pressure to allow greater access to this information. Perhaps, as Katz suggests, telecommunications transaction information will be redefined as public information to be made increasingly available. This suggests that the preference for legislative or regulatory relief which is common among the older segments of the population will increasingly be frustrated.

Conclusions and Recommendations

The primary lesson seems to hinge on the development of technology and practices which maximizes the power of the individual to control how the collection and use of personal information will proceed. In similar fashion, the best response to the "invasions" which the ringing telephone represents is that which allows the individual the greatest freedom to decide which calls will be accorded particular rights of access to the individual or family. Technical solutions which maximize the freedoms of both parties should be supported.

These concerns are concerns of relative power. At the very least, individuals in their home should have the same kind of power to select from among incoming calls as bureaucratic organizations have to select from among callers, from applicants, from petitioners, and the like. At the present moment, the balance of power is tipped dramatically in favor of the bureaucratic organization (Gandy,1989). If the law and the the market for communications technology can redress that balance, than these are the avenues we should explore.

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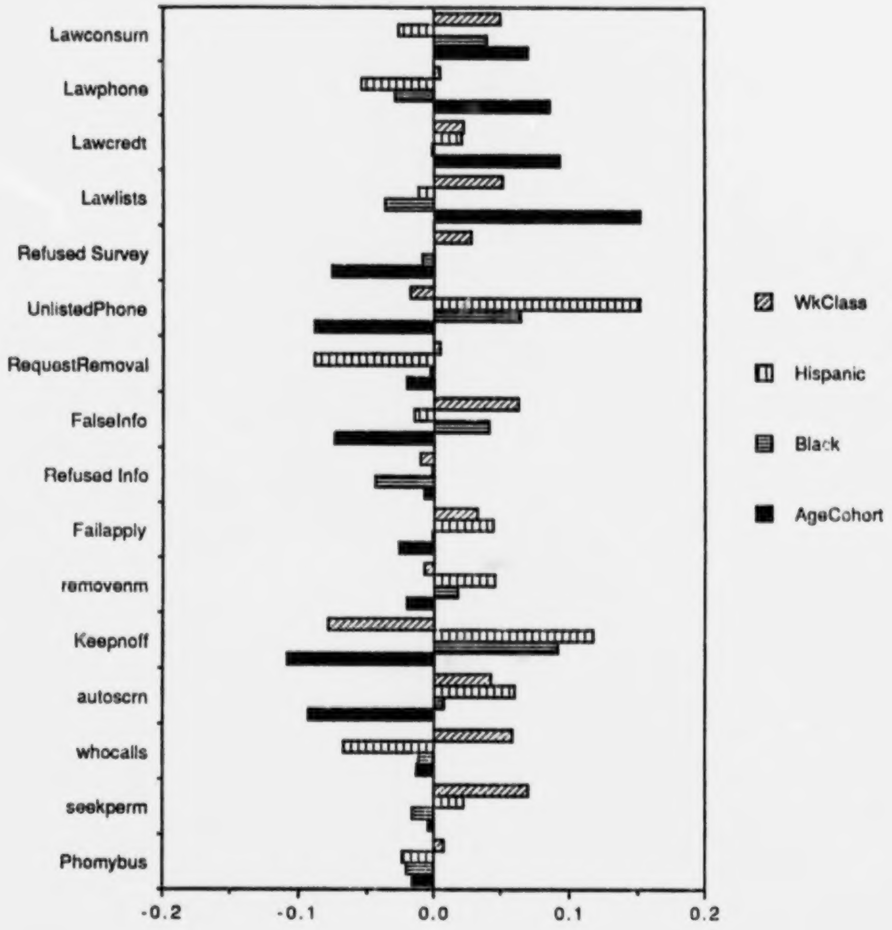
Figure One

Partial Correlations

(Controlling for Education and Income)



Rethinking Universal Service in Australia: Community Service Obligations and the new regulatory environment.(1)

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ABSTRACT

A central goal of Australian communication policy has been the provision of a universal telephone service - access to telephone services throughout Australia on a non-discriminatory, uniform basis and at affordable prices. This paper critically examines how this policy goal is being reformulated in a changing economic and political climate.

1. THE BACKGROUND

As recently as the late 1970s, when an Australian domestic satellite was being considered for the first time, it was noted that access to Australia's telecommunications and broadcasting systems varied quite markedly.

The 1977 Inquiry into an Australian domestic communication satellite found that residents of the major cities of Sydney and Melbourne, had access to high quality telephone, telecommunications and postal services, and up to twenty radio, and five color television services. On the other hand, some residents of the remote outback had to be content with an irregular postal service and an unreliable two-way High Frequency (HF) radio service as their links with the outside world. For many residents in the remote outback, broadcast television and telephone services were non-existent, short-wave radio provided the only timely news and entertainment service and unreliable HF radio provides the only communication link for business, health and educational services.

Of course not everyone fell at the extreme ends of the spectrum. While many people outside the major cities had high standard telephone services they had to be content with far fewer radio and television broadcast services than those in the major cities. For example, in 1977, it was estimated that more than 3.5 per cent of the population (490,000 people) lived outside the service areas of the national television service and 1 percent of the population could not expect to receive television services by conventional means. When the people who lived within television service areas and received inadequate or unsatisfactory reception were taken into account 10 per cent of the population (1.4 million people) received either an inadequate or no national television service. (Australia, Task Force on a Satellite System, 1977;17) Access to commercial television was even less satisfactory.

As a consequence, one of the major justifications for the creation of AUSSAT, Australia's domestic communication satellite, was to overcome this imbalance in access to broadcasting services. Limited direct broadcasting from AUSSAT, and re-regulation of commercial broadcasting to encourage networking meant that most regional centres would receive three commercial television programs and one national service. Residents in the remote outback could receive a satellite delivered service which included national and commercial television and radio services.

While Aussat was able to compete with Telecom Australia in the provision of services including television networking services and the provision of private networks, Telecom Australia's statutory monopoly on the supply of most telecommunications services remained undisturbed. The political and economic reasons for this are complex, but one of the major justifications for protecting Telecom's monopoly lay in the argument that orderly development of the national network and the creation and maintenance of universal telecommunications service required the subsidy of unprofitable telecommunications services by those which returned profits. Conventional wisdom held that profits from the major inter-city trunk routes provided a subsidy for unprofitable services which were provided in country areas. Direct competition from Aussat would reduce Telecom's ability to cross-subsidize its loss-making services. The economic and political imperatives of Australia's geography and demography was used to maintain Telecom's statutory monopoly on most telecommunications services.

While the creation of Aussat could have had profound effects on domestic telecommunications in Australia, its effects were essentially marginal to the income and activities of Telecom Australia.

2. CHANGING CONTEXTS

The international winds of regulatory reform and entrepreneurial pressure to allow greater competition in the provision of telecommunications services led the current Government to reexamine its telecommunications policies. As a consequence the Minister for Transport and Communications' May 1988 announcement that the Government intended to restructure telecommunications in Australia was motivated by the Government's awareness that technological and economic developments, new service opportunities and new national and global market opportunities and imperatives required a rethinking of Australian telecommunications policy (Minister for Transport and Communications, 1988).

The Government believed that an efficient telecommunications system which could provide advanced services was crucial to the success of key growth industries in the economy. At the same time there was a recognition of the Government's continuing responsibility to ensure the maintenance of appropriate equity in the provision of essential telecommunications services. (Minister for Transport and Communications, 1988;2).

3. THE NEW AUSTRALIAN POLICY FRAMEWORK

The new telecommunications framework announced in May 1988 attempted to strike a balance between the twin objectives of economic efficiency and equity. This was achieved through the creation and clarification of roles, new forms of regulation, and a clear separation of Telecom's social and commercial responsibilities.

The new framework clearly separated the development of policy from regulation and service delivery. A new regulatory authority, Austel, assumed the regulatory functions, some of which had previously been carried out by Telecom. And the Department of Transport and Communications was given the responsibility of advising the Minister on policy development.

The new telecommunications framework also introduced more competition into the telecommunications industry. From July 1, 1989 the supply and maintenance of all customer premises equipment, except for the first telephone, and all value added services, was be open to competition. In addition to regulating telecommunications services, Austel will review Telecom's monopoly control over the mobile telephone network and the supply of the first telephone.

However Austel is also required to protect Telecom's monopoly rights over the supply of certain "reserved services". Telecom's monopoly in these areas has been justified because it has been argued that competition would not increase the efficiency of providing a national infrastructure and because it was believed that the profits derived from monopoly services were necessary to cross-subsidize loss-making community service obligations. Debate about cross-subsidies in Australian telecommunications is not new. But the explicit terminology of community service obligations has only recently been applied.

The tension between providing services at a uniform tariff despite the wide range of costs involved in providing those services has been resolved though the use of cross-subsidies. Profits from some services have been used to subsidize the services which have been provided at tariffs which are below the cost of providing those services. Historically, decisions about how those cross-subsidies should be both derived and applied have been the responsibility of Telecom. One view has been that Telecom's tariff policy has been to use the inter-city trunk routes between Adelaide, Melbourne, Sydney and Canberra and Brisbane to subsidize loss-making suburban and rural telecommunications services. A Bureau of Transport and Telecommunications Economics study will clarify this issue (Shaw, 1989).

Under the previous regulatory regime there was no explicit requirement for Telecom to report on the nature and scale of cross-subsidies and how those cross-subsidies were being financed. One consequence of this process was that the social and economic costs and benefits of those cross-subsidies could not be adequately debated or assessed.

Telecom's ability to readily apply surpluses from one sector of its operation as subsidies for other sectors was made possible because there was no competitive pressure to bring tariffs close to the costs of providing services. Without competition, Telecom had the ability to decide on how it should balance its tariffs. But the move to place Telecom and the other Government Business Enterprises (GBEs) on a more commercial footing and to introduce competition has fundamentally changed the rules of the telecommunications enterprise.

The short and long term possibility of competition required that the scale of cross-subsidies being provided would have to be made explicit. Without that information the Government would be unable to set the ground rules for the entry of competitive suppliers of telecommunications services. With increased competition, Telecom's ability to provide cross-subsidies will be eroded as tariffs are driven towards costs. While these pressures will increase economic efficiency, the rebalancing of tariffs has significant social implications.

But there is another strong justification for the Government to assess the cost of meeting social policy objectives through the cross-subsidies. With or without the introduction of competition in the provision of telecommunications services it is important for government's to have information about the precise costs of its social policy programs. This information is essential for social policy planning and in the consideration of alternative mechanisms for funding those objectives.

Information about the scale of cross-subsidies involved in meeting the Government's social policy objectives is also becoming increasingly important in the debate about the structural reform of the Australian economy. Here the debate centres on the extent to which government policies in a range of areas impact on the international competitiveness of Australian industry and Australia's ability to enter the international trade in service (Industries Assistance Commission, 1989b; Industries Assistance Commission, 1989a).

The Minister noted that any move to change the structure of pricing the standard telephone service would raise significant social and community concerns and that the Government could not, and would not, ignore this dimension of its responsibilities. He also stated that the Government accepted that social concerns bearing on telecommunications will remain important in the years to come. The Minister acknowledged that a key question was how a universal service was to be maintained while moving towards pricing structures which were consistent with the economic and market imperatives of the emerging information economy (Minister for Transport and Communications, 1988:24).

The Government also acknowledged that there was a need to minimize the impact of re-regulation on the provision of basic telephone services. The Government was going to act on the understanding that there was a need to maintain and extend universal service by fully maintaining Telecom's ability to provide access to standard telephone services through cost-averaging and cross-subsidy (Minister for Transport and Communications, 1988;30).

4. COMMUNITY SERVICE OBLIGATIONS

Given the social importance of telecommunications service the Government affirmed that a primary objective of the new telecommunications policy would continue to be the provision of universal access to a standard telephone service throughout Australia on an equitable basis and at an affordable price (1988;3). This would become Telecom's "community service obligation" (1988;24). The Minister noted that the tariff for basic access to services for the majority of residential metropolitan users and for most country services was set below cost, (1988;24) and that he expected that the funding of Telecom's community service obligations would require some form of cost averaging or cross-subsidy (1988;44).

A major feature of the new policy environment was the move to bring Telecom's community service obligations within the Government's control and accountability provisions. The Minister noted that the progressive identification and detailed costing of community service obligations is necessary so that the Government can specify what it expects of Telecom. Also it allows for a clearer understanding of the extent to which social and other non--commercial objectives are being met. It also enables the cost of such obligations to be taken into account when Telecom's financial targets are determined (Minister for Transport and Communications, 1988;162).

Even though cross-subsidies played an important part in the tariff structure of Australian telecommunications there was no agreement on the size of the cross-subsidies which were involved in meeting what was now defined as Telecom's community service obligations. And even more fundamentally there was ongoing debate about how the costs of those community service obligations should be conceptualized and measured.

As a consequence the Minister directed that the Bureau of Transport and Communications Economics (BTCE) and Telecom should prepare a report on the costs and cross-subsidies associated with meeting identifiable community service obligations which were currently being met by Telecom. Community service obligations currently being examined include a universal service for standard telephony, public pay phones, charitable concessions and services for the disabled. (Shaw,1989).

5. THE LEGISLATIVE PACKAGE

In April 1989 the Government translated the broad thrust of the May 1988 Ministerial Statement into law. Among other things the legislation established Austel as an independent regulator of the telecommunications industry. The legislation also specified Telecom's community service obligation as the supply of a standard telephone service between places in Australia. (The standard telephone service is defined as the public switched telephone service.) According to the new legislation Telecom is obliged to ensure that the service is reasonably accessible to all people on an equitable basis wherever they reside or carry on business. Telecom must ensure that it supplies the standard telephone service as efficiently and economically as possible. And Telecom is obliged to ensure that the standard telephone service meets the social, industrial and commercial needs of the Australian community (Australian Telecommunications Corporation Bill, 1989:27).

Additionally the cost of carrying out Telecom's community service obligations is one item which must be included in Telecom's Corporate Plan. This plan must be submitted to the Minister for approval. The Minister has the specific right to direct Telecom's Board of Directors to vary strategies and policies which are designed to achieve its community service obligations (Australian Telecommunications Corporation Bill, 1989:36). The cost of carrying out Telecom's community service obligations is to be taken into account when the Minister and Telecom's Board of Directors come to an agreement on the financial targets which are embodied in Telecom's Corporate Plan.

Also Austel the industry regulator, has the responsibility of monitoring and reporting to the Minister on the "appropriateness and adequacy of the strategies and policies that Telecom is following to carry out its CSOs". And Austel is to monitor and report on the "efficiency with which Telecom is carrying out its community service obligations" (Telecommunications Bill, 1989:22; Explanatory Memorandum, Telecommunications Bill, 1989:9).

The legislative definition of Telecom's community service obligations and the monitoring processes raise a number of important issue which are worth close examination. The next section of this paper will examine these issues in some detail.

6. THE NEW INTELLECTUAL CLIMATE

As was noted earlier, one of the Government's principal objectives is to improve the efficiency of the telecommunications system. The strategy being adopted is to increase Telecom's commercial accountability by articulating Telecom's community service obligations and to gradually liberalize the telecommunications market by creating competition in the provision of some services. It can be seen that the explicit specification of community service obligations has emerged as a result of this new thinking about the provision of telecommunications services.

In the old regime the provider of telecommunications services acted as an arm of government in attempting to provide universal access to telecommunications services. In the past, Telecom's goal to provide universal access to the telephone was explicitly stated. Telecom's responsibility was ..." so far as it is reasonably practicable to do so, make its telecommunications services available throughout Australia for all people who reasonably require those services" (Telecommunications Act, 1975:6). Telecom was providing a public service where the logic of commercial undertakings was subsumed by the logic of providing a government-mandated service.

But the new mode of thinking places the provision of telecommunications in a more commercial framework. Organizations such as Telecom which had their origins as service supplying government departments are now explicitly seen as Government Business Enterprises (GBEs). This contrasts with the earlier public service view of telecommunications which saw telecommunications as contributing to the pursuit of normative social and political priorities which may override strictly economic or technical criteria (Garnham, 1988;43).

The Australian telecommunications policy intitiatives are not occurring in a vacuum. They should be seen as a part of a world wide trend. Although they take a peculiarly Australian form, they are another manifestation of economic liberalism which is gaining increasing favor. This movement sees smaller government, greater reliance on market mechanisms, and reduced direct government involvement in the provision of goods and services which can be offered by the private sector as fundamental to economic reform (Henderson, 1989).

The Minister's Second Reading Speech stressed the point that the Australian Government saw "the commercialization of GBEs as a fundamental precondition to improvements in efficiency (Minister for Transport and Communications,1989:1). It is this tension between Telecom's newly mandated commercial objectives and the provision of services on non-commercial terms which is at the heart of the debate about Telecom's community service obligations.

7. SECTIONAL VIEWS OF COMMUNITY SERVICE OBLIGATIONS

The tension between Telecom's newly mandated commercial objectives and the provision of services on non-commercial terms is made more acute when Telecom's non-commercial responsibilities are linked to the maintenance and possible extension of its monopoly on certain services.

According to large users of telecommunications and potential entrants to the telecommunications market, community services obligations can be used to both justify and enlarge Telecom's monopoly. According to this view community service obligations can place unnecessary costs on certain telecommunications users because they are forced to subsidize other users. Cross-subsidy of this form is seen as an economically inefficient way of transferring resources (Bureau of Transport and Communications Economics, 1988;8-9).

Potential entrants to the competitive value added service market are also interested in reducing the possibility that revenues from Telecom's non-competitive or reserved services could be used to support Telecom's activities in competitive markets (Alston, 1989). As a consequence they are interested in policies which progressively open up the telecommunications market to competition and reduce Telecom's ability to cross-subsidize its activities in competitive areas. The popular metaphor is that of a "level playing field" where all participants are playing on equal terms.

Others argue that there is no need for Telecom's monopoly to be protected because of its community service obligations. It is argued that the subsidies involved in providing services below cost are relatively low in relation to the overall income of the organization. According to this argument most large business organizations practice some forms of internal cross-subsidy without the need for government protection and Telecom should be able to operate in such a way.

A variation of this argument sees Telecom's extensive infrastructure as a natural protection against competitive threats. According to this view, given growth in telecommunications business and the steadily reducing costs involved in providing telecommunications services, Telecom should be able to provide community service obligations up to some benchmark without needing regulatory protection from potential competitors.

Others see community service obligations as merely an "accounting fiction" which will enable the Government to vary the rate of return which Telecom will pay the Government on its capital investment.

Another argument presented was that justification for maintaining the monopoly is weaker given Telecom's current penetration rate. With approximately 94% of all households connected to the network, and with a greater proportion of metropolitan households connected, and some of the remaining households choosing not to be connected it can be argued that the creation of a viable telecommunications network has already occurred. According to this view the maintenance of a monopoly on significant parts of the network as a way of providing cross-subsidies is not justified. Rather than preserving or extending the monopoly it is now possible to see the domain of the monopoly being progressively reduced.

Yet another view argues that even if the Government does have an obligation to provide universal access to the telecommunications system at an affordable price, the use of cross-subsidies is not justified. According to this view the community service obligation issue and cross-subsidies have become unnecessarily conflated. According to this view there is no necessary relationship between community service obligations and cross-subsidies. It is argued that if the Government has set itself a social policy objective it should be prepared to underwrite the costs of that objective from taxation revenue. It should not be the responsibility of some groups of telecommunications users to directly subsidize the telecommunications services of others.

On the other side of the argument is the view that equitable access to telecommunications services funded through cross-subsidy is one manifestation of the Government's obligation to guarantee access to a minimum range of essential services. Telecommunications service appropriate to the needs of special groups are seen to be as important as other health, education and welfare services.

Remote and rural telephone subscriber organizations make even stronger claims. They argue that the telephone is a "total life support system" which is integral to business, health, education, social interaction and community and industry organizations in rural and remote areas. Government community service obligations policies are seen as guarantees of access to a range of essential services.

Another view sees the specification of the costs and beneficiaries of community service obligations as the first stage in their gradual removal. According to this view explicit cross subsidies are subject to the vagaries of the political process so that in times of economic hardship they can be progressively reduced.

So it can be seen that the debate about community service obligations is a debate about the social and economic role of telecommunications in Australian society.

8. DEFINITIONAL ISSUES

(i) What is mandated for "universal" provision?

There has been a significant change in the kind of service which Telecom is obliged to provide throughout Australia. The Telecommunications Act, 1975 defined Telecom's obligations as the widespread provision of "telecommunications services" (Clause 6.1). But the Telecommunications Bill, 1989 defines Telecom's universal service responsibility in terms of a "standard telephone service" (Clause 27.4.a). It is quite obvious that the new legislation is much more specific, and that it mandates the provision of a more clearly defined service.

(ii) What is the standard telephone service?

The legislation does not provide an operational definition of a "standard telephone service". One view sees this as a negative aspect of the legislation because there is no legislative guarantee of a minimum universal service. The opposing view sees this lack of definition as a virtue. The definition of what is seen as "standard" could provide the Minister with a great deal of flexibility. According to this view, the lack of a definition makes it possible for the Minister to define or redefine the standard telephone service from time to time. (This process of definition could involve Austel being asked for advice on such a definition.) This would make it possible to take advantage of new technological opportunities and encourage Telecom to diffuse innovations throughout the network.

While the lack of a definition of the standard telephone service could be seen as a positive aspect of the legislation there is no legislative direction on the process which would be followed in arriving at such a definition. It is unclear whether there is any obligation on either Austel or the Minister to provide a publicly accessible definition of the standard telephone or whether the definition of the standard telephone service would be something which was internal to the negotiations surrounding the approval of Telecom's Corporate Plan.

It is apparent that the definition of the standard telephone service is a high priority issue because throughout the Ministerial Statement and the resulting legislation the "standard telephone service" is been presented as unproblematic. But is the notion of the "standard telephony" unambiguous? What is the relationship between the "standard telephone" and the network itself? Given that intelligence is progressively being added to the network, how does that transform the notion of a "standard telephone service"? For example is International Subscriber Dialing (ISD) a basic or enhanced network service? What would be the status of a caller identification capability or "follow-me" routing through the public switched network? The legislation and the accompanying documentation is mute on these points.

Intertwined with this definitional point is an issue raised by the uneven quality of standard telephone services throughout Australia. Sound business practices encourage Telecom to give top priority to enhancing the telecommunications network in areas which can generate the greatest revenues. As a consequence central business district subscribers are most likely to benefit from technological innovations such as enhanced switching capabilities before subscribers in suburban or rural areas. This uneven distribution of services raises questions about the practical definitions of the standard telephone service. How will the functionality of the standard telephone service be defined? Will there need to be different definitions of the standard telephone for different geographic areas?

If a standard telephone service will be defined differently for different areas, what assumptions are being made about the rate of diffusion of network innovations? Will there be some specification of the rate by which innovations will be diffused throughout the network?

It has been suggested that it would not be in the interests of Telecom, or any carrier for that matter, to either develop or unnecessarily perpetuate a telecommunications system with different standards of service. The added complexity of switching between the different service standard areas would encourage the development of a uniform standard of service. But granted this point, the rate of diffusion of innovations would need to be addressed.

(iii) How might definitions of the "standard telephone service" differ among user groups?

On the basis of exploratory work undertaken for Telecom, Maureen Le Blanc argues that there is a consistent and well-considered definition of the kind of telephone service which should be provided to all Australians at an affordable cost (1989). According to Le Blanc this standard telephone service involves automatic, universal access to local STD and ISD facilities. Significant numbers of participants in the study also believed that billing information should contain detailed itemization of STD and ISD calls.

Le Blanc also reported that participants believed that everybody should have access to value added services and data transmission facilities on a "user pay basis". So access to the latest modern technology should be a part of the basic service with everybody having the ability to choose to use it or not (Le Blanc, 1989;3)

So while telephone subscribers might be in general agreement on what constitutes a minimal telephone service it is possible that what is taken to be the actual standard telephone service will vary amongst users. Definitions of the "standard telephone service" could vary between different user groups. One might expect that definitions would vary on a number of factors. These include whether the telephone system is being used for private or business purposes. For example business users might wish to connect business communications equipment such as computers or facsimile machines to a standard telephone service. As a consequence they might require different service quality standards from those of a domestic user.

Remote subscribers might have greater dependence on the telephone for a range of information, health and safety related services. Access to data services, with a requirement for lack of noise on lines, might be a higher priority for some rural users. Urban subscribers who have alternative sources of information readily available might be less concerned with this issue.

The age of subscribers might also determine what they regard as a standard telephone service. Given the dependence of the aged and infirm on the telephone (Tinker, 1989) and the proliferation of services which are designed to meet their special needs it is possible that aged persons would define a standard telephone service in quite specific ways. People with specific physical disabilities would also have quite distinct views of what they would see as a standard telephone service. It has been argued that disabled people should have the same kind of access to telecommunications services that is available to the rest of the community. This should not be seen as "charity" or "welfare" but as the provision of a basic and essential service which is available as a right.

These examples suggest that community expectations will define what is taken to be a standard telephone service and that those community expectations will vary between user groups. Also these community expectations will be influenced by a number of factors. Telecommunications carriers and the marketers of telecommunications services and equipment will promote products and services which will eventually impact on community expectations of what a standard telephone service should offer. Also the services which are marketed for business use will increasingly penetrate the domestic market. As a consequence the definitions of a standard telephone service will be dynamic.

(iv) How does technological change alter new definitions of the "standard telephone service" ?

It is useful to consider how notions of the "standard telephone" have changed over time. If community service obligation policies had been enacted in the 1950s what kind of telephone network would have been considered to be standard? Quite obviously, expectations of what is a standard service or product change quite rapidly. In the last few years it would have been possible to find communities who saw party line, manually switched services as the standard telephone service. At the same time there would have been metropolitan telecommunications customers who had access to all the benefits of computer controlled exchange services

Following the work reported by Le Blanc it is possible to think of definitions of the standard telephone service altering in steps. At some time and place there is an accepted view of what constitutes a standard telephone service.

Contemporaneously there is a view that some set of additional services should be available as a right, but purchasable as an optional extra. As diffusion of these innovations occurs, those additional services are considered to be elements of a standard telephone service (1989;4). It has even been suggested that the specification of what is a standard telephone service could be tied to the penetration of innovative services. For example, when an enhanced service has reached, or is used by 80% of subscribers it could be seen as Telecom's community service obligation to provide that service to the remaining 20% of subscribers as a part of a basic service. Garnham suggests that this is one of a number of policy options which can be used to treat new telecommunications service (1988,46).

If the definition of the "standard telephone service" was static for an extended period of time it could have the effect of locking out certain groups of customers from new features. These new features might cost little to offer and they could mean that telecommunications providers would lose potential revenue. (This would happen if at some time in the future, if something like STD or ISD access was considered to be an enhanced service and not part of a standard telephone service.)

A major tension in this area would be the possibility that Telecom's actual and potential competitors might argue that network and service enhancements which Telecom could see as evolutionary developments of the standard telephone service should be seen as "value added services" and hence not a part of its "reserved service" and therefore open to competition. The demarcation of these boundaries is clearly an issue where Austel will have an active role.

The task for the Government and Austel will be to reconcile and make allowance for the possibility of multiple definitions of a "standard telephone service". It will also need to consider the costs and benefits of re-specifying the standard telephone service which would be offered as a part of Telecom's community service obligations. In the long term it will be important to review the community service obligation policy in the light of its effects on innovation, development, and the use and distribution of new telecommunications services.

9. FUNDING COMMUNITY SERVICE OBLIGATIONS.

Of course the acknowledgement and specification of community service obligations can be separated from the question of funding. In the past what have become known as community service obligations have been funded through cross-subsidies, but there are other options which are available.

The Bureau of Transport and Communications Economics (1988;9) has argued that there are four relatively distinct ways in which community service obligations can be funded. These include:

a) direct payment by government;

b) payments from within the industry such as through industry levies;

c) payments from users of other services provided by the Government Business Enterprise such as with cross-subsidies;

d) indirectly by governments using other forms of internal funding such as the acceptance of lower dividends.

The decision of the Government to exclude competition from the public switched network allows for a cross-subsidy from one set of users to another, (c) above. While the Government's involvement in negotiating rates of return in the Corporate Plan on the basis of the costs of community service obligations is an example of a funding mechanism described in (d).

Given the creation of Austel as a forum for debate on telecommunications issues it is likely that the funding of community service obligations will continue to be debated. The debate will be between those who see community service obligations as a responsibility which should be directly funded by the government and those who see community service obligations as a charge which should be levied against telecommunications users who can afford to pay.

10. CONCLUSIONS

The following issues arise from the previous discussion.

a) There is a need to realize that community service obligations are only a means of conceptualizing and achieving certain social policy goals. While it is reasonable to pay attention to the means of achieving certain policy objectives, as is the case with the community service obligation debate, it is important to acknowledge that the ultimate social policy goals need to be addressed. Debate about "means" should not detract from debate about "ends". As a consequence it is important for the Government to undertake an ongoing examination of the social and economic goals of the Australian telecommunications system. As these change, the means of achieving these objectives will need to be reexamined and adjusted.

b) There is a need to think of community service obligations as fluid. This arises because neither technological opportunities nor social and economic objectives are static, or can be readily predicted. While it is easy enough to specify emerging technologies which could have profound implications for social and economic life it is hard to be precise about the nature of those implications. The pre-history and history of modern telecommunications technology is littered with predictions which have been turned out to be remarkably inaccurate. A re-reading of those predictions tells us more about the assumptions and the social context of those making the predictions than it does about the actual future of those technologies (Pool, 1983; Marvin, 1988).

This enforced humility about our ability to forecast the development and the social applications and consequences of communications technologies encourages us to consider an alternative strategy. What is needed is an ongoing process which allows for debate and decision-making about social and economic goals of the telecommunications system. These goals can then be related to the opportunities afforded by the emerging technologies. There is a need for a clearer identification of the social goals of telecommunications policy and the appropriate mechanisms for achieving those goals.

c) Another important conceptual issue relating to the underlying assumptions of telecommunications policy has been that community service obligations should be considered as geographically-based issues. The costs of providing rural and remote services have encouraged the belief that geographical isolation and lack of services is and should be the principal goal of the community service obligation policy. Given that there is almost universal access to telecommunications services in Australia the focus might now move to a closer investigation of access to, and use of the telecommunications system in urban, suburban and rural areas. For example do the Government's general policies or Telecom's commercial policies make actual connection to or use of the telecommunications system difficult for specific groups of people? It is possible that attention to this issue will reveal that specific groups defined by their socioeconomic status, ethnicity or physical disability might be revealed as needing special attention. Once that identification has been made it is possible to think of how those differential needs should be met and whether or not those needs should be seen as a part of Telecom's community service obligation.

d) And finally it has been argued that community service obligations are determined as a result of the complex interplay between technological possibility, community expectation, notions of a desirable telecommunications infrastructure and other government initiatives. As a consequence it is possible to conceive of community service obligations as unique to particular times and places. But, more importantly, it is possible to conceive of community service obligations as dynamic and changing over time. The notions of a "basic service" and a "standard telephone" are not static and future telecommunications policy and regulation should take this into account. As a consequence there is a need to develop procedures which can allow for the specification and re-specification of telecommunications objectives, social goals and community service obligations over time. In essence there is a need to regularly reexamine the meaning of "universal service".

NOTES

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REGULATORY REFORM FOR HAWAII'S TELECOMMUNICATIONS INDUSTRY

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ABSTRACT

While other states are rethinking and reforming their regulation of the telecommunications industry, Hawaii continues to regulate providers of telecommunications services in the same inflexible manner it regulates providers of other utility services. The state's regulatory machinery catches virtually all manners and forms of intrastate telecommunications offerings. Providers of competitive services face formidable barriers to entry. Those that enter find themselves subject to costly and burdensome oversight. This decidedly unfriendly regulatory environment ensures the absence of small companies and serves to forestall the introduction of innovative technologies. A different result requires prompt legislative intervention.

1. INTRODUCTION

Public utilities, being businesses "clothed with a public interest," have been traditional and popular subjects of governmental regulation in the United States. The states were the first to regulate private utility enterprises. Federal regulation was introduced later to promote national and international interests. The result is a dual system of requirements pursuant to which utilities must conform their behavior and operations.

In recent years a number of industry sectors, including telecommunications, have experienced substantially relaxed regulation at the federal level. The nation's move to reform its regulatory framework coincides with the rapid pace of technological advancement within the communications and information processing fields. The new technologies are said to make regulation less necessary and competition more appropriate.

The State of Hawaii has been positioning to benefit from the hi-tech revolution. The state views itself as uniquely situated, from geographical (spacial as well as temporal), cultural, and linguistical perspectives to attract information oriented businesses. These industries are expected to diversify the state's economic base with minimal environmental and social impact.

The information businesses, if they come, will be telecommunications providers themselves or they will rely heavily on communication services provided by others. To this end the governor declared 1988 to be the "Year of Telecommunications in Hawaii"; the Hawaii Legislature created and funded a government body -- Hawaii INC -- to promote and develop the state's information industry; the legislature commissioned and funded a study of selected telecommunications issues of concern to the state; and the state plan was amended to include information processing and an expanded state telecommunications infrastructure among previously enunciated state goals. [1]

Meanwhile a large majority of states have caught the federal wave of regulatory reform by adopting flexible approaches in their regulation of intrastate telecommunications providers. Yet the deregulation wave has, for the present, passed Hawaii by. Hawaii continues to oversee providers of public communications services in the same manner it did at the beginning of this century, applying to them all the same requirements, guidelines and standards applied to the other utility sectors.

Hawaii's inability to reform seems at odds with its push to become a hi-tech center and exporter of information services. Businesses that rely heavily on communications services are unlikely to be motivated (despite the weather) to relocate to a jurisdiction which adheres to an archaic regulatory regime. This paper reviews Hawaii's regulatory environment as applied to telecommunications services, raises questions regarding the appropriateness and legality of the regulatory treatment, and offers directions for reform.

2. HAWAII'S REGULATORY FRAMEWORK

The regulation of public utilities began in Hawaii in 1913 with the promulgation of a statute now codified as chapter 269 of the Hawaii Revised Statutes (HRS). The local exchange company (LEC), Hawaiian Telephone Company, was organized in 1883, prior to regulation under the laws of the Kingdom of Hawaii. HRS sec. 269-7.5 requires all public utilities (except those operated by government bodies and those already existing) to obtain a certificate of public convenience and necessity (CPCN) before commencing business. Application for CPCNs are made to the Hawaii Public Utilities Commission (HPUC). The HPUC is the state regulatory body empowered by and whose job it is to implement the requirements of chapter 269.

Chapter 269 does not for the most part distinguish between types of utilities. Telecommunications companies are subject to the same statutory requirements, and to the same degree of HPUC oversight, as other types and manners of public utilities. Once certified, all aspects of utility operations become the subject of HPUC review and approval. HPUC filings are often complex and costly, the process for the fixing of rates and tariffs being particularly onerous and time consuming. The Hawaii Legislature has relaxed the statutory requirements in a few narrow areas but not yet insofar as the requirements apply to telecommunications providers.

State regulation is limited to intrastate utility activities. Extraterritorial matters are the exclusive province of the federal government. Interstate and international telecommunications services are regulated, if at all, by the Federal Communications Commission (FCC) which exercises authority Congress delegated to it in the Communications Act of 1934.

But interstate and intrastate communications facilities are integrated by their nature and design. That is to say much of the same plant and equipment is utilized to provide both intrastate and interstate services. It becomes impossible, logically, to determine where intrastate regulation should end and interstate begin. To the extent federal and state laws (or regulations) conflict, the federal laws prevail. Placed in the context of telecommunications services, so long as the FCC acts within the delegated scope of its authority, it has the ability to preempt interfering state statutes, state rules, and state commission decisions.

Not all utilities need concern themselves with the dual regulatory environment. A resident carrier who provides no intrastate service can only be required to satisfy the federal law. The HPUC is without jurisdiction to regulate such providers. One might argue, therefore, that Hawaii's inflexible regulatory regime is unlikely to dissuade an information provider whose primary markets are interstate and international.

Yet it is the rare hi-tech business that will have no intrastate communications needs. Consider the nationwide paging service proposed last year in Hawaii by the Telefind Corporation. Telefind provides forwarding services for subscribers of existing paging companies enabling the customer to be paged while traveling outside the local service area. Telefind's service was intended primarily for persons traveling out of state, but it could also be used to forward pages among service areas within the Hawaiian Islands. Because of this incidental use Telefind was obliged to seek a CPCN and look forward to full state regulation. After experiencing the burdens of the regulatory process, Telefind. withdrew its HPUC application and restricted itself to interstate messaging. [2]

The promotion of diversified economic growth on Hawaii's outer-islands plays a major role in the state's plan to attract information oriented businesses. Information enterprises locating on a rural island can anticipate substantial intrastate communications needs for two reasons. The first is that businesses will continue to look to Honolulu for many of their basic day-to-day needs. The second is that all interstate and international communications gateways are presently located on Oahu. The information exporter on Maui, Kauai, or the Big Island will therefore be exporting via Oahu.

3. TELECOMMUNICATIONS SERVICES THAT ARE PUBLIC UTILITIES

Hawaii's regulatory arm is long in that it reaches operations which form a part of the interstate and international communications network. The arm also reaches deeply to catch many local activities which seem rather more private than they do public. This expansive regulatory regime is primarily the result of broad language found in HRS sec. 269-1, according to which a public utility includes:

> every person [or entity] who may own, control, operate or manage as owner, lessee . . . or otherwise . . . any plant or equipment, or any part thereof, directly or indirectly for public use, for the . . . conveyance or transmission of telephone or telegraph messages, or the furnishing of facilities for the transmission of intelligence by electricity by land or water or air within the State, or between points within the State. . . .

The HPUC has had a number of occasions to construe this definitional provision in the context of actions brought by telecommunications service providers hoping to avoid local regulation. In almost every instance the commission determined the provider to qualify as a public utility, and consequently, for regulation. There have been two exceptions only.

One involved a reseller of cellular telephone services who proposed to purchase, wholesale, mobile services from the two locally licensed cellular carriers and then resell those services to subscribers. The second exception was the case of a provider of operator services who proposed to offer answering services, message services, and wake-up services to hotel occupants over lines leased from the LEC. In the first case, Re Motorola Cellular Service,[3] the applicant testified it would own no plant and equipment, and the HPUC found the service outside the definition of public utility on that basis. The latter case, Re Telecommunications Services, Inc. (TSI),[4] was decided without the benefit of evidence, comments, or a hearing. The HPUC ruled the service there not a utility because TSI would lease and not own lines, because customer premises equipment (CPE) had been deregulated, and because TSI would use none of its own plant and equipment in providing the message services. Yet later, when the same company proposed to make available shared tenant type facilities for transient occupants of vacation condominiums, others contended this would make it a public utility. See Re Hawaiian Properties, below.

In all other dockets the HPUC has determined telecommunications service providers to be public utilities. Re Shared Tenant Services (STS) [5] is an investigative docket instituted by the commission to include a determination of whether STS providers qualify as public utilities. Hopeful providers intervened and argued that because STS is offered to a discrete and strictly limited number of individuals, it falls short of qualifying as a public utility. The LEC and Consumer Advocate (CA) instead contended that a mere handful of subscribers is sufficient to bring a service within the purview of chapter 269.

Parties favoring regulation found language helpful to their cause in two Hawaii Supreme Court decisions. In the first, Re Wind Power Pacific Investors - III, the court affirmed a HPUC ruling that a private power producer selling excess power to the local power utility was not obliged to obtain a CPCN. Quoting outside authorities, the court declared that:

> The test is, therefore, whether or not such person holds himself out, expressly or impliedly, as engaged in the business of supplying his product or service to the public, as a class, or to any limited portion of it, as contradistinguished from holding himself out as serving or ready to serve only particular individuals. [6]

The issue before the court in the second case, PUC v. Honolulu Rapid Transit, was whether a defunct transportation carrier continued to qualify as a public utility for purposes of paying annual public utility fees. By way of dicta, the court explained that:

> In general one who interprets HRS sec. 269-1 must bear in mind that the statutory scheme of HRS ch. 269 displays a public policy that favors PUC jurisdiction over activities where the public welfare depends on proper conduct and regulation. [7]

The HPUC concurred with the LEC and CA, and borrowed the Wind Power language to hold that STS providers would, for the most part, be considered public utilities required to apply for CPCNs and to submit themselves for plenary HPUC regulation. The commission reserved the issue of whether all STS providers would be public utilities and acknowledged its obligation to examine individually each case of proposed service.

State commissions elsewhere have split on the question of whether STS providers are public utilities. Some finding STS subject to regulation were overruled by their respective legislatures. States having flexibility in their regulatory machinery held STS a utility of the type not requiring rigid oversight. Hawaii's machinery does not permit such flexibility, and as yet the Hawaii Legislature has not overruled the HPUC's STS decision.

Other HPUC communications dockets are consistent with the inclusive construction given public utility in the STS case. In Re Tel-Net Joint Venture I,[8] the HPUC found the proposed intra- and inter-island high speed digital microwave data transmission service offered to a small number of financial institutions to qualify applicant as a public utility. In Re Radiocall Corporation,[9] intrastate radio paging service providers argued against regulation on two grounds: first, that lawmakers could not have intended regulation of a technology which did not even exist at the time of chapter 269's promulgation; and second, that the statutory language, when applied literally, leads to absurd results. Neither argument prevailed and all intrastate paging service providers were held obligated to secure CPCNs. And in Re COCOTS, the commission examined the issue of whether owners or lessees of customer owned coin operated telephone services (COCOTS) would be required to apply for CPCNs. The commission ruled COCOTS providers to be utilities explaining:

> The record indicates that COCOTS equipment will be of a "public character" when offered at airports, shopping centers and hotels. Even if the service is offered to the public as a limited class, such as restaurant patrons, we are of the opinion that the service is of a "public character and of public consequence" under the Hawaii Supreme Court's decision. [10]

HPUC dockets in which the commission avoided or has yet to decide the public utility issue are instructive for the positions taken and arguments made. In Re Hawaiian Electric Company, Inc.,[11] the local power company sought a declaratory ruling that it be allowed to use existing power conduits to offer a single institutional client fiber optic transmission of voice and data. The LEC contended the proposed service would infringe its right to provide local exchange services, and the CA claimed the service would require applicant to obtain a CPCN (on top of its existing power franchise). The commission withheld its permission on alternative grounds. In Re Hawaii Health Services, Inc.,[12] a local health care provider proposed to offer STS for its own use but also for health care professionals who might lease office space on the hospital premises. The LEC intervened contending applicant would need a CPCN according to the commission's STS decision, and the application was withdrawn soon thereafter. Similarly in Re Hawaiian Properties, Ltd. v. Hawaiian Telephone Co.,[13] complainant, a manager of real estate and rental properties including tourist condominiums, proposed to offer STS type facilities for its temporary and transient lodgers. Again the LEC intervened contending the matter was more properly covered by the STS docket. The case proceeded on other issues and was subsequently withdrawn. Finally there is now pending before the HPUC in Re American Telephone & Telegraph,[14] a proposal by AT&T to offer card operated public telephone service. Because local calling is to be included in the service, both the CA and LEC contend a CPCN is a prerequisite.

Together these cases illustrate the commission's willingness and inclination to construe chapter 269 broadly to catch almost any conceivable telecommunications service having an intrastate element. Yet this result does not appear mandated by the statutory language. STS providers, for example, provide communication services to limited, sometimes very limited, environments -- a single building, part of a building, a tract development, or between branch locations of a single company. The arrangement may involve a "resale" of LEC services such that the STS operator makes a profit. Other times the services are merely "shared" between subscribers with no profit (although the LEC maintains this arrangement also constitutes "resale" of its services). In any event subscribers would be few in number, qualified by the special circumstance of being a tenant or owner in the STS building, and not necessarily barred from choosing the LEC service instead. Why, then, are such persons "a limited portion of the public" and not merely "particular individuals"? Moreover, are limited STS arrangements really what the Hawaii Supreme Court had in mind when it described "activities where the public welfare depends on proper conduct and regulation"? The same questions might be posed in relation to a COCOTS service offered at a service station or restaurant, or an intrastate private line service offered to a limited number of financial institutions.

The commission's decisions are troubling in another respect. The LEC's tariff prohibits the resale of local services but includes an exception for hotels and hospitals where the provision of telephone service is ancillary to the providers main business.[15] The resale exception makes good practical sense, but the tariff legitimizes by implication the activities of the hotels and hospitals that utilize it. The HPUC has never attempted to explain why hotels and hospitals may legally offer telecommunications services without a CPCN, whereas COCOTS and STS providers may not.

The HPUC's expansive interpretation of public utility holds significant implications for Hawaii's information enterprises. In 1988 the Hawaii Legislature created Hawaii INC, a public corporation whose purpose it is to encourage the development and growth of the information industry within the state. A major part of Hawaii INC's role is to serve as an interface, in the manner of a gateway, between state data bases, private information providers, and information consumers. This will involve the transmission of information, and lots of it. The corporation itself will not be subject to HPUC regulation because chapter 269 exempts utilities owned or operated by political subdivisions; but many of the services Hawaii INC hopes to encourage probably will be.

4. THE PUBLIC CONVENIENCE AND NECESSITY

For many companies, the expense and other burdens of regulation will be sufficient disincentive to their attempting to offer communication services within Hawaii. None of the putative STS providers have filed an application for CPCN. Yet for the company willing to bear the inconveniences of state regulation, the battle is just begun. Authority to provide services as a public utility is granted only to those capable of establishing that they meet the rather stringent criteria required for a CPCN.

Any enterprise desiring to offer services the HPUC regards as qualifying it as a public utility must apply for and obtain a CPCN. HRS sec. 269-7.5(b) directs that a certificate shall issue

> if it is found that the applicant is fit, willing and able properly to perform the services proposed . . . and that the proposed service is, or will be, required by the present or future public convenience and necessity; otherwise such application shall be denied.

Fitness, willingness, and ability to perform the services proposed involve a review of the applicant's financial position, plant and equipment, permits and licenses, and other elements all of which lend themselves to reasonably objective inquiry. The "present or future public convenience and necessity" however is a less objective standard, inviting drawn out evidentiary battles.

For the telecommunications provider, the relevant CPCN issues are: (1) whether the LEC has an exclusive franchise to provide some or all the state's telecommunications services; (2) whether the public convenience and necessity requires communications providers in addition to the LEC; and (3) whether the promotion of competition is a factor legitimately included in the public convenience and necessity equation.

As regards the first issue, it is now fairly certain that the LEC, which in the case of Hawaii serves the entire state, does not have an exclusive franchise to provide for all the state's telecommunications needs. The LEC also likely cannot claim exclusivity as to any particular element of telecommunications service (although it appears to have argued otherwise in the *Re Hawaiian Electric* fiber optic docket). In *Re Tel-Net Joint Venture II*,[16] the HPUC awarded Tel-Net a CPCN to provide high speed digital microwave transmission despite the LEC's objections. In *Re Radiocall Corporation* the HPUC, while ruling on the public utility issue, pointed out that it had certified a number of radio paging services which offer services in direct competition with the LEC. And in *Re Motorola Cellular Service*, the commission noted that Oahu was being served by two licensed cellular telephone carriers, one related to the LEC and the other independent from it.

The harder questions concern the nature and extent of the evidentiary showing required to achieve the public convenience and necessity threshold. Hawaii courts have had but one occasion, in *Re Charley's Tour & Transportation, Inc.*, to interpret the statute's "public convenience and necessity" language. The case involved competing common carriers by land, and the Hawaii Supreme Court elaborated on the public convenience and necessity evidentiary requirement.

> The burden is on the applicant to show that the proposed operation not only will be of beneficial value to the community, but also is a necessity. Generally, the applicant may meet this burden by demonstrating either a lack of

> adequate existing facilities to presently serve the public, or insufficient facilities to meet anticipated future demands for service. . . . The Commission may authorize the certificate even though other existing carriers might be fit, willing, and able to furnish successfully the proposed service. [17]

This suggests an extremely difficult burden for providers of comparable services, though not an impossible one.

The HPUC has certified companies to provide the same or similar communications service on a number of occasions. In all but one of these the result appears to have been mandated by federal law. The FCC has affirmatively established a competitive policy in the areas of radio paging, described in the Radiocall decision, and mobile telephone services, described in the Motorola decision. It is therefore doubtful the HPUC could have legally withheld certification of competitive carriers in either situation.

Only in the Tel-Net II docket did the HPUC certify the provision of competitive telecommunications services absent a federal directive. Tel-Net maintained that it alone was in a position to offer fully digitalized high speed inter-island data transmission. The LEC could offer comparable service but only on partially digitalized circuits. Because pure digital data transmission was described as more reliable, the Tel-Net service was found different from that being provided by the LEC and necessary to the public convenience. The commission, relying upon the language in Charley's Tour & Transport, concluded that, where in the public interest, it may authorize a service despite the existence of another authorized carrier able to provide the same service, and despite the possible negative impact on the LEC's revenues.

The Tel-Net II decision is welcome precedent but does little to relax a very tough entry requirement. Most alternative service providers will not be able to establish their service as qualitatively different from that available from the LEC. In Tel-Net II the applicant argued its application had provided the LEC with the incentive to offer a comparable service. The LEC is well positioned to move into new service markets and also to wait, until properly motivated, to make the move. The possibility of retaining unto itself an additional domain of service exclusivity could provide the motivation.

Other commissions state and federal, considering the public convenience and necessity issue in the context of telecommunications services, have concluded that the promotion of competition can be considered as assisting in the satisfaction of, or itself sufficient to meet, the public need standard. As explained recently by the Massachusetts Department of Public Utilities:

> [T]he Department specifically rejected the position that public need be interpreted narrowly ". . . to mean that there is a specific unmet demand for the proposed service or that consumers are unable to purchase comparable services from an alternative supplier. The requirement of the public must be analyzed in the context of the market environment." In reviewing the telecommunications market, the Department has found that a competitive marketplace for telecommunications services in Massachusetts has "the clear potential of encouraging the development of a more efficient and modern telecommunications network. . . ." For these and other reasons . . . we have consistently held that the promotion of competition, through the removal of overly restrictive regulatory barriers to entry, meets the public need standard. [18]

The HPUC has acknowledged that competition can play a role in the public convenience and necessity inquiry, but appears to have done so without easing the burden facing the market entrant. In the COCOTS docket the commission described its view of competition in regulated communications services:

> If the market, in absence of competition, is already operating in an efficient manner, it makes no economic or regulatory sense to permit competition for competition's sake alone. However, where the market is operating inefficiently and where competition promotes efficiency, the allowance of resale may be in the public interest and should be allowed. [19]

The commission found the COCOTS providers had failed to discharge their burden of establishing the LEC's coin telephone service to be inefficient and ruled, therefore, that COCOTS was "not in the public interest at this time." Not surprisingly, COCOTS entrants (with the possible exception of AT&T) have refrained from filing applications for CPCNs.

Yet the commission described a very different aspect of competition in the Motorola case. There the commission determined that the resale of cellular services would not require a CPCN. Then, as though to justify the resulting lack of regulatory oversight, the commission explained it "anticipated that competition [among resellers] will provide adequate protection for users of resold cellular mobile service." [20]

Nothing about the language of chapter 269 would appear to preclude the HPUC from finding, as the Massachusetts commission has, that competition can be a positive factor to be weighed in the public convenience and necessity test. The Hawaii State Plan describes the state's telecommunications objectives in terms of "dependable, efficient and economical." [21] It does not make mention of competition per se. Very recently the CA, in the AT&T docket, described a pro-competition stance for those markets "where ratepayers will benefit economically and receive improved service." [22]

But the HPUC might also conclude, as it appears it may already have, that the promotion of competition among telecommunications service providers is a matter for legislative and not agency action. The legislature has indicated an interest in treating the subject. As with the issue of deregulation discussed below, the commission could be said to circumvent the legislative will were it to act in areas of purposive legislative inaction.

5. REGULATORY OVERSIGHT

Assuming a telecommunications provider accepts the regulatory challenge, and further, is fortunate enough to establish its services as necessary to the public convenience, can it then look forward to flexible regulation? As already described, regulation involves a multitude of administrative tasks both expensive and time consuming. For the major utility company, regulation is just one of many expenses recovered in the ratemaking process. For the small telecommunications company, the cost of regulation may be unreasonable relative to projected revenues. Notwithstanding, the small utility is subject to virtually the same magnitude of regulatory burden as is the state-wide provider of a basic utility service.

Market entrants in the *STS*, *Tel-Net I*, *Radiocall*, *Telefind*, *COCOTS*, and *AT&T* dockets all raised the prospect of minimal or relaxed regulatory oversight. All requests for flexible regulation have been denied (except for AT&T's, whose soon will be). In *Radiocall* the commission correctly explained that it lacked the authority to relax statutory requirements.

> Where there is no specific power provided by law to exempt an industry that is defined as a public utility, we are of the opinion that the Commission has no power to unilaterally decide that, changing circumstances or other factors notwithstanding, the paging service industry can be deregulated. We believe that this view is consistent with the Supreme Court's dicta [in *PUC v. Honolulu Rapid Transit* that] "Chapter 269 displays a public policy that favors PUC jurisdiction over activities where the public welfare depends on proper conduct and regulation."
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> * * *
>
> [T]he Commission has previously held *Re Tel-Net Joint Venture* . . . that "[t]he issue of deregulation is a legislative matter and the Commission must exercise these powers that have been delegated to it by the legislature." [23]

6. REFORM THROUGH ADJUDICATION

Communications providers unhappy with the state's regulatory machinery can wait for legislative reform. Or they can actively challenge the propriety and legality of the regulation. Unfortunately the opportunities for adjudicative reform are limited, difficult, expensive, and not particularly likely to succeed.

The simplest and most direct avenue for challenge would be to the HPUC itself, asking that it narrow somewhat its concept of public utility in communications cases. Entrants found to be utilities should continue pressing competition as a legitimate consideration to the public necessity and convenience inquiry. The statute would seem to permit the HPUC this flexibility and the present commission has indicated a willingness to reconsider issues taken up and decided by previous commissions.

For those services designed to be offered to a very limited number of end-users, the provider might argue that a finding of regulatory jurisdiction is inconsistent with the constitutional protection of private rights. The due process clause tolerates economic regulation as a valid exercise of the government's police power so long as the target industry is "affected with a public interest." [24] All traditional manners of utilities fit easily within this test. But not necessarily all new forms of communication services designed for small groups and special circumstances.

Some have suggested the HPUC should relax its regulation of telecommunications providers through a rulemaking proceeding. Rulemaking, an otherwise appropriate administrative vehicle for regulatory evolution, can only accomplish that which the statute allows. As pointed out by the HPUC in *Radiocall*, chapter 269's many mandatory directives leave little to be made flexible. A rulemaking proceeding is powerless to change this situation.

Challenge by way of inviting federal preemption is a more adventurous possibility. The FCC has authority to regulate (or deregulate) all interstate and international services, including those which are located wholly within a state and those sharing physical facilities with intrastate services. In regards to these shared facilities, state regulations which conflict with or "frustrate a legitimate federal policy" may be rendered invalid. FCC preemption of state regulation of CPE, inside wiring, and enhanced services have so far been upheld. Attempts to preempt other areas impacting intrastate service have been less successful. In *Louisiana Public Service Commission v. FCC*, the U.S. Supreme Court held the FCC oversteps its authority whenever it preempts state tariffs which merely interfere with or frustrate federal policy objectives. On the other hand, the Court reaffirmed the Commission's power to nullify state tariffs which negate or directly conflict with federal tariffs, and specifically confirmed the FCC's authority to deregulate CPE. [25] Post-*Louisiana* the FCC has preempted, *inter alia*, a state commission decision which the Commission viewed as interfering with the customer's "federal right of interconnection." [26]

State authority to regulate intrastate telecommunications services is circumscribed to the extent that the FCC has preemptive authority which it exercises. The HPUC has deferred to the FCC in the unbundling and detariffing of CPE. [27] In other areas the commission has shown less enthusiasm towards relinquishment of its regulatory jurisdiction. Federal preemption was argued in the *Radiocall*, *STS*, *COCOTS*, *Tel-Net I*, *TSI*, and *Motorola* dockets. The HPUC specifically rejected the contention in Radiocall and STS, but accepted it in TSI as an independent reason to justify its decision not to regulate.

The HPUC's assertion of jurisdiction to set tariffs and conditions for the provision of STS, COCOTS, cellular and other intrastate communications services it finds to be public utilities is probably correct. Less clear is whether the commission's jurisdiction includes the authority to place near-insurmountable barriers in the path of prospective providers of some of these services. Both STS and COCOTS utilize the same physical facilities in their provision of intrastate and interstate services. Both are located on the customer's (loosely defined) premises. State regulations which render interconnection impossible or uneconomic might be held to frustrate an area of asserted federal regulatory jurisdiction. Previous attempts to raise such issues before the FCC have not resulted in preemption, but neither have they foreclosed the possibility. [28]

A final but most difficult avenue for adjudicative reform is via anticompetition proceedings. Chapter 269 requires utility rates and practices to be just and reasonable and prohibits those found unreasonably discriminatory. In Tel-Net v. Hawaiian Telephone Co. I,[29] the complainant alleged the LEC had engaged in predatory pricing by dropping its rates for a competitive private line service from $910 per month to $129 per month. The HPUC dismissed the complaint after finding the reduced rate to be cost-based. Prospective entrants and dissatisfied competitors may also bring private antitrust actions directly in the courts. However actions charging monopolistic practices, already complicated, are made more difficult by a number of defensive immunities available to industries under regulation.

7. REFORM THROUGH LEGISLATION

Reform through legal challenge is unsatisfactory for a number of reasons. It is slow. It is uneven in that change is brought about in piece meal fashion. It promotes uncertainty and is subject to reversal. It is expensive for all involved, and it occupies the time and the staff of already busy tribunals.

Legislative reform, the reform of choice, is made difficult by politics. The Hawaii Legislature got off on the right foot (though a little late) when it commissioned in 1988 a study of issues concerning the state's telecommunications industry. The study concluded with a number of suggestions including recommendations for relaxed regulation and regulatory flexibility.

The 1989 legislative response to the study was disappointing. The legislature entertained several measures designed to implement the study's recommendations. One resolution not adopted sought to inject competition into the inter-island toll telephone service. [30] Another, adopted by the house but not the senate, called upon the HPUC to investigate the LEC's rate structure, inter-island toll rates, and the favorable effects of competition. [31]

An unsuccessful bill proposed an alternative statutory structure for the flexible regulation of telecommunications utilities. [32] It would have allowed the HPUC to waive chapter 269 requirements for qualifying telecommunications providers, but only pursuant to an extraordinarily comprehensive proceeding. Interested parties claimed to support the bill's intent but objected to its form, each for a different reason. The commission quite correctly pointed out that the proposed statute was too complicated to be workable. The CA believed the bill lacked sufficient consumer safeguards (though the bill's complexity appears to have perhaps resulted from the inclusion of too many safeguards). The LEC objected that, according to the draft law, its status as dominant service provider would render it ineligible for regulatory relief. [33]

The only 1989 telecommunications bill to become law is one introducing additional regulation. Senate Bill 1426 (Act 241 of 1989) adds "aggregators of telephone services," defined as persons who make available to their customers access to alternative operator services (AOS), to the list of entities over which the HPUC has regulatory jurisdiction. The new law is intended to prevent in Hawaii abuses experienced at the hands of AOS providers by consumers in other states. Query whether, but for the new law, the HPUC could have asserted jurisdiction over aggregators providing access for local service.

The legislative task of selecting an appropriate statutory vehicle for regulatory reform is made easier by the experience of other, faster-acting states. It has been several years since the first states introduced flexibility into their regulation of telecommunications. Many states now have such laws, and the laws take a variety of forms. [34] The Hawaii Legislature is therefore in the enviable position of being able to sit back and choose the option most appropriate to its state's circumstances.

The new regulatory machinery the legislature chooses for its telecommunications industry should be one that is friendly to the hi-tech businesses and services it seeks to attract to the Islands. The lawmakers should of course remain cognizant of the needs of the residential telephone subscriber and the local exchange company. But they should also take account that the beneficiaries of relaxed regulation, many of whom are not aware they stand to benefit, are unlikely to be represented by lobbyists.

The new law should not dictate the form or amount of competition to be injected into the industry. Nor should it attempt a comprehensive itemization of concerns generic to the deregulation question. The HPUC is far better equipped, than are lawmakers, to sift through and isolate the important issues and inquiries. The commission has demonstrated an inclination to take a considered approach to new matter. The legislature need only give it direction in the form of generalized objectives and guidelines. Above all the new statute must endow the commission with discretion, because discretion in its regulation of telecommunications providers is exactly what the commission does not now have. Considering that the regulatory process is not known for speed, the sooner the commission is given this discretion the better.

8. CONCLUSIONS

The Hawaii Public Utilities Commission operates under a statute permitting it no flexibility in the degree to which it regulates public utilities. All services which qualify as public utilities must obtain certificates of public convenience and necessity. The promotion of competition is not recognized by the commission as being necessary to the public convenience. Only services which are of public convenience and necessity obtain certification. Once certified, the utility is subjected to burdensome and expensive requirements which bear little relation to its size, the scope of its territory, or the nature of its service.

The HPUC has limited discretion in determining the services that qualify for public utility status. Thus far the commission has exercised its discretion broadly to assert jurisdiction over most manners of telecommunications providers. The positions taken do not always seem justified but, considering the loose statutory language, neither probably are they in error.

Such a regulatory environment all but forecloses the small provider of telecommunications services from attempting to enter Hawaii's telecommunications market. Timely legislative action is required before this situation can be expected to change.

A number of now familiar arguments against relaxed regulation have been made repeatedly at both the federal and state levels. These include that competition in the provision of telecommunications services will result in stranded investment and "cream skimming", leaving residential customers to pay higher monthly telephone bills, that it will undermine progress towards universal service, and lead to market failure and then to unrestricted monopoly power. Such arguments undoubtedly have merit and undoubtedly many aspects of intrastate communications services should and will continue to be subject to regulatory oversight.

Equally certain, however, is that Hawaii's present regulatory environment is inhospitable to many new opportunities in communications technology and service, and unnecessarily so. For each argument against regulatory reform there is a counterargument. Relaxed regulation in appropriate markets can result in higher usage of basic services and, consequently, higher revenues for the LEC. Economies of scale and scope which underpin the natural monopoly concept of the traditional utility are inapplicable to some, though not all, of the new communications offerings. Perhaps most important is that many of the telecommunications services being made available today lack the essential quality and character which substantiate governmental regulation of the more traditional service sectors.

Both the LEC and the CA claim to be in favor of reform, but each hold tenaciously to "concerns" serving to forestall legislative action. It may be unfair to expect interested parties to relinquish objectives basic to their respective missions. But it should not be too much to expect lawmakers to look beyond special interest issues and mold the appropriate solution.

NOTES

[1] Act 1 of the 1988 Special Session both created the Hawaii Information Network Corporation (Hawaii INC), codified as HRS ch. 206P, and amended the Hawaii State Plan, HRS ch. 226.

[2] In re Application of Telefind Corporation for a Certificate of Public Convenience and Necessity, HPUC no. 6201 (withdrawn February 13, 1989)

[3] In re Application of Motorola Cellular Services, Inc. for Declaratory Ruling, HPUC no. 5429 (D&O no. 8876 filed August 28, 1986)

[4] In re Application of Telecommunications Services, Inc. for Declaratory Ruling, HPUC no. 5522 (Order no. 8701 filed March 31, 1986)

[5] Re Hawaiian Telephone Co. - Investigation of Shared Tenant Services, 91 PUR4th 324 (HPUC no. 5560, D&O 9686 filed March 4, 1988)

[6] In re Wind Power Pacific Investors-III, 67 Haw. 342, 345, 686 P2d 831, 834 (1984)

[7] Hawaii Public Utilities Commission v. Honolulu Rapid Transit, 56 Haw. 115, 119, 530 P2d 742, 745 (1975)

[8] In re Application of Tel-Net Joint Venture for Declaratory Ruling, HPUC no. 5335 (D&O no. 8433 filed August 9, 1985)

[9] In re Application of Radiocall Corporation for Declaratory Ruling, 84 PUR4th 663 (HPUC no. 5689, D&O no. 9215 filed June 5, 1987)

[10] In re Application of Hawaiian Telephone Company for Approval of COCOTS Tariff, HPUC no. 5563 (D&O no. 9492 filed September 22, 1987, at p. 7)

[11] In re Application of Hawaiian Electric Company, Inc. for Authority to Offer Private Fiber Optic Transmission Service, 87 PUR4th 227 (HPUC no. 5777, D&O 9530 filed October 8, 1987)

[12] In re Application of Hawaii Health Services, Inc. for Declaratory Ruling, HPUC no. 6138 (withdrawn July 25, 1988)

[13] In re Hawaiian Properties, Ltd. v. Hawaiian Telephone Co., HPUC no. 6232 (withdrawn February 22, 1989)

[14] In re Application of American Telephone & Telegraph for Declaratory Ruling, HPUC 6438 (filed May 18, 1989)

[15] Hawaiian Telephone Company's HPUC Tariff No. 1, Sec. 2, Rule 27

[16] In re Application of Tel-Net Joint Venture for a Certificate of Public Convenience and Necessity, HPUC no. 5336 (D&O no. 8639 filed February 12, 1986)

[17] In Re Application of Charley's Tour and Transportation, Inc., 55 Haw. 463, 469, 522 P2d 1272, 1277 (1974)

[18] Re International Telecharge, Inc., 97 PUR4th 349, 353 (Mass. DPU 87-72, 88-72 filed October 11, 1988)(applicant for CPCN may prove existence of public need through promotion of competition and removal of overly restrictive regulatory barriers to entry). See also In re Petition of New Ulm Telcom, Inc., 399 NW2d 111 (Minn. App. 1987)(not error for Minnesota commission to conclude that the public convenience and necessity would be served by allowing telephone companies to compete for inter-exchange toll service).

[19] In re Hawaii Telephone Co. - COCOTS Tariff, supra note 10, D&O no. 9492 at 8.

[20] In re Application of Motorola Cellular Services, Inc., supra note 3, D&O 8876 at 6.

[21] HRS sec. 226-18. Compare the objectives for the economy-information industry, HRS sec. 226-10.5, which include the development and expansion of the telecommunications infrastructure and, in a separate subsection, the development of new information business and service ventures. That the state plan for telecommunications is lumped together with the plan for energy, and not together with the plan for the information industry, may add to the confusion.

[22] Testimony of the Consumer Advocate at pp. 4-5, submitted September 18, 1989, in In re Application of American Telephone & Telegraph, supra note 14.

[23] In re Application of Radiocall Corp., supra note 9, 84 PUR4th at 671-72.

[24] Nebbia v. New York, 291 U.S. 502 (1934); Munn v. Illinois, 94 U.S. 113, 126 (1877).

[25] Louisiana Public Service Commission v. FCC, 476 U.S. 355 (1986)(especially footnote 4 at p. 375).

[26] Atlantic Richfield Co., Mem. Op. & Order, 3 FCC Rcd 3089 (1988), modified, 3 FCC Rcd 3080, aff'd sub nom. Public Utilities Com'n of Texas v. FCC, 886 F2d 1325 (DC Cir. 1989)

[27] Re Hawaii Telephone Co. - Investigation of Customer Premises Equipment, 67 PUR4th 645 (HPUC no. 5013, D&O no. 8364 filed May 31, 1985)

[28] One FCC challenge to the LEC's refusal to provide access for customer owned coin telephone service was abandoned pending the outcome of the HPUC COCOTS docket. In re Business Phones Hawaii, Inc. v. Hawaiian Telephone Co., File no. E-85-41, 2 FCC Rcd 1607 (1987). An FCC inquiry into the issues raised by state regulation of STS, In re Policies Governing the Provision of Shared Telecommunications Services, CC Docket no. 86-9, 102 FCC2d 1421 (1986), was terminated without a preemption order. But in determining not to preempt broadly, the Commission noted that its complaint process remained available for the individual situation where preemption might be warranted. 54 Telecommunications Reports no. 44 at 29 (November 7, 1988)

[29] Tel-Net Joint Venture v. Hawaiian Telephone Co., HPUC no. 6073 (D&O no. 10205 filed May 8, 1989) Tel-Net filed for protection under Chapter 11 of the Bankruptcy Act in September of 1988, during the pendency of this HPUC docket.

[30] HR 204; HCR 183.

[31] HR 130; HCR 108.

[32] HB 1667, HD 1.

[33] Testimony on HB 1667, presented March 2, 1989, before the House Committee on Consumer Protection and Commerce.

[34] See, e.g., Idaho Code sec. 62-601 et seq., allowing providers the option of traditional regulation with an exclusive franchise, or minimal regulation without; Indiana Statutes sec. 8-1-2.6-1 et seq., authorizing the commission after notice and hearing to decline to exercise jurisdiction over telephone services, with but a few guidelines; Utah Statutes sec. 54-8b-1 et seq. and Washington Code sec. 80.36.300 et seq., both of which permit the relaxed regulation, after hearing and specified findings, of services subject to effective competition; and Virginia Code sec. 56-531 et seq., which provide a relaxed regulatory regime for small (less than $30,000,000 in revenues) telephone utilities.

Session 2.6

Policy Change and Private Sector Marketing in the Pacific Telecommunications Market

Chairs: Jane Hurd, NTIA
Robert Reisner, Putnam, Hayes & Bartlett

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Tuesday, January 16

Working Groups

Background Papers

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Evaluating Instructional Telecommunications Programs

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1. ABSTRACT

This paper will examine the data sources and variables that should be considered when evaluating instructional telecommunications programs, and the way the results of data analysis can be used to improve the quality of the instructional program. Examples will be drawn from an examination of the evaluation systems developed and administered by the Arizona State University instructional television office over the past eight years. Results of the analyses will be discussed in order to provide examples of the way analysis can be used to improve telecommunications programs.

2. BACKGROUND

In early 1982 Arizona State University constructed an Instructional Television Fixed Services (ITFS) system to serve the metropolitan Phoenix area. The system uses twelve frequencies to provide four channels of ITFS programming. Programming (primarily upper division and graduate credit courses) is delivered live to a group of students in a campus classroom and simultaneously broadcast over the system. The cost of constructing this system (including four "studio/classrooms" at the main campus was well in excess of one million dollars. In order to evaluate the effectiveness and efficiency of this system as an instructional delivery vehicle, semi-annual (during the first year) and annual evaluations have been conducted since the system began operation.

When Arizona State University (ASU) built its Instructional Television Fixed Services (ITFS) system in 1982 it was expected to be a break-even operation. The principle source of revenue for the system was tuition and broadcast surcharges. The clients were high-tech and other industrial clients using the system to provide continuing education opportunities for their employees.

3. THE SYSTEM

3.1 ORIGINATION EQUIPMENT

At the ASU campus four classrooms were retrofitted for the origination of ITFS programming. Each classroom is equipped with three cameras: an overhead camera used for displaying material on the instructor's podium; a medium range camera used to show the instructor at the podium; and a long-range camera used to show chalkboard and wide angle shots of the classroom. An operator in an adjacent control room controls the operation of the cameras by remote control. Students in the classroom pose questions and make comments by activating microphones located on the student tables. This allows student comments to be fed into the broadcast signal. A telephone located at the podium allows students at remote sites to call during classes and ask questions. Video, film, and slide/tape media can be accommodated by the system.

All signals are fed to a master control facility via fiber optic transmission. Fiber optic was chosen for its exceptional signal quality. At master control all signals are monitored by a full-time engineer.

3.2 TRANSMISSION EQUIPMENT

Signals are broadcast from the campus using four ITFS frequencies (G- Group). Approximately 10 miles southwest of campus, at South Mountain, the four frequencies are received and re-broadcast on four additional frequencies (A- Group). Another set of four frequencies (E-Group) are utilized on a mountain at the northern edge of the valley. All transmitters operate at 10 watts. This system provides coverage for the entire metropolitan area.

3.3 RECEPTION EQUIPMENT

Signals are currently received at 22 remote sites. Two of these sites are remote campus extensions of ASU. The other 20 sites are located in businesses throughout the metropolitan area. Sites receive the signal from the closest set of transmitters. Downconverters are used to transform the high frequency signals into the VHF range. All four channels are available at each site. Companies utilize from one to four classrooms for the reception of programs. Each classroom is equipped with television viewing equipment. Telephones are available in each classroom allowing students to interact with the instructor during classes. Existing phone lines provide the audio system for interaction with the ASU classroom.

4. EVALUATION SYSTEM

Evaluation has been a key component of the program since its inception. Over the years the types of data collected have varied, but the goal has remained the same: to strive for excellence in instruction. Many telecommunications systems focus on achievement as an indicator of success in instruction. We, too, evaluate the achievement of our students; however, we also evaluate many other variables ranging from the quality of the camera operators shot selection to the speed of homework delivery at the remote site.

4.1 DATA COLLECTION

Data has been collected from students, faculty, and company administrators. Data has been collected in four different ways: records of achievement; administration of survey instruments; interviews; and observation in the classrooms. Surveys are generally designed with both selected-response and constructed-response items. A sample selected-response item would look like this (where the appropriate response is circled):

The audio signal was clear.

Almost always
Usually
About half the time
Occasionally
Rarely

Constructed-responce items pose questions, for example "What did you like most (or least) about the course", or "What recommendations do you have for improving the technical system?".

Obviously, quantitative analysis is most appropriate for achievement records and survey data. The most appropriate analysis is often comparison of means or percentages for alternative responses. However, when attempting to answer specific questions analyses have ranged from simple t-tests to factor analysis, including everything in between. Much useful information has been gleaned from the "analysis" of more qualitative data. Studying the responses to open-ended questions often reveals potential problems. Viewing programming in the remote environment can provide insights into strengths and weakness of the system. Observing the behavior of students during classes can yield information useful for system improvement.

4.2 ACHIEVEMENT

4.2.1 Data Sources, Collection Techniques & Variables

Achievement data (i.e., grades) are normally obtained from the computerized records available from the university's student database. Each remote site is given a unique section number for every course available. This allows faculty members teaching the class to receive class rosters indicating where a student will be viewing the class. It also facilitates the billing of companies for the television surcharges (which are almost always paid by the students' employer, rather than the student). An additional benefit is that this system makes it easy to identify whether students in a course are participating on-campus or off-campus. It also allows for an analysis of performance by remote site, to check for anomalies in performance that might indicate irregularities in the administration of tests or other course assessments. It also permits comparisons between students participating at ASU remote campuses versus those participating at company sites.

4.2.2 Results

Analysis of data indicates that students at remote sites perform as well as students in the campus classroom. From semester to semester there are differences in performance, sometimes statistically significant differences. However, the direction of the difference varies, sometimes favoring remote students, and other times favoring the in-class students. Some of the classes offered at campus are so large that students view the course from an on-campus remote classroom. While these students are "on campus" they are in an environment similar to that of the off-campus students (i.e., they watch the classes on TV and interact with the instructor using the telephone system). When it became clear that there were in fact differences between the performance of in-class students and remote students, the logical question was whether these differences were due to the system or to differences between campus students and students working at companies. The remote campus group of students made it possible for us to address this question. Since the students at campus were assigned to either the live classroom or the remote classroom on the basis of random selection, any differences in the performance of the two initially homogeneous groups should be the result of system influences. The lack of difference would seem to indicate that any difference between the remote and live groups were due to other student factors (e.g., age, work status, etc.). In fact analyses of the two campus groups reveal no significant differences, indicating that the system is probably not a factor in performance.

On a case-by-case basis performance data have also been analyzed to identify differences among students by remote site. Instructors occasionally notice that students at a particular site seem to be performing exceptionally well or poorly. Using this observation, follow-up data analyses have identified problems ranging from improper test administration to rigid policies limiting access to classes. These problems are generally easy to resolve once identified.

4.3 TECHNICAL SYSTEM

4.3.1 Data Sources, Collection Techniques & Variables

Data related to the technical systems are generally collected either by surveying the students or by observing at the remote site. Survey data is generally reported in percentages of responses in a particular category. The major variables for data collection include: quality of the television system (audio signal, video signal), production quality and telephone linkages.

4.3.2 Results

Both the audio and video transmission signals are of exceptionally high quality. Overall, over 85% of students respond that the signals are clear. However, the same has not always held for the ability of the system to reproduce the questions posed by students in the campus classroom. Initially, only 37% of the students reported that they could hear the questions at least half of the time. We determined that the problem was caused by the microphones we were using. In order to make the system as transparent as possible to students in the campus classroom we originally installed voice-activated microphones in the classroom. The results of our first two evaluations made it clear that these microphones were not performing satisfactorily. Setting the activation thresholds at a point where questions were being transmitted without transmitting every cough and chair movement proved impossible. We addressed the problem by installing push-button activated microphones in the classrooms. While that has ensured that extraneous noise is not transmitted, it necessitates students depressing the button when they want to ask the instructor a question. These microphones have eliminated the technical problem. However, in almost every subsequent evaluation problems caused by the failure of students to depress the microphone buttons have surfaced. We minimize this mechanical problem in two ways: by having the instructor remind students to push the button, and by having the camera operator occasionally flash a message on the TV screens in the classroom, reminding students to press the microphone buttons.

The quality of the production is generally high, but is variable depending on the camera operator. Problems related to camera operation are generally addressed during the training sessions for each operator. Since the broadcast signals are available on campus our training specialists systematically observe classes to evaluate the production quality, and to remediate operators where necessary. Operators generally work fixed hours during the week. This makes it possible to evaluate survey data (which is anonymous by student, but marked by class) keeping an eye on the performance of individual camera operators. When an end-of-semester evaluation indicates that a production problem is persistent, we either provide additional remediation or terminate the employee.

4.4 SUPPORT SYSTEM

4.4.1 Data Sources, Collection Techniques & Variables

Data related to the support systems are generally collected by surveying the company administrators, the faculty, and the students. Survey data is generally reported in percentages of responses in a particular category. The support system includes the courier service, computer support, and course registration.

A courier makes daily deliveries to each of the remote sites, each of the participating campus instructional units, and the campus computer center. Handouts, tests, graded homework and computer printouts are sent to the students at the remote sites, with ungraded homework and completed tests returned from the remote sites to the instructor. Prior to each semester registration is facilitated through the instructional television office. For companies with large numbers of students on-site registration is also provided.

4.4.2 Results

Perceptions of the quality of the courier service are in the eye of the beholder! The company coordinators (who receive the materials) almost always indicate that materials are received on time. However, they often indicate that not enough copies of materials are received (a function of the instructor's preparation of materials). Students, on the other hand, respond that materials are received on time approximately 80 % of the time. This difference in perception was clarified by follow-up observations. It turned out that materials were almost always received on time, but often sat in the coordinators' offices for some time before being disseminated to students. Bringing this to the attention of the company coordinators minimizes the problem.

Faculty members have a somewhat lower (50%) level of satisfaction with the return of materials to them in a timely manner. Additional analysis reveals that there are two possible explanations: faculty have a low response rate to surveys (under 50%), making accurate assessment of the magnitude of the problem difficult; and the fact is that students often do not return assignments on time, which is outside the domain of the support system!

There is almost unanimous agreement that registering for televised courses is easy and convenient. Since most of the students at remote sites have had experience with walk-through registration at campus, they understand and appreciate the convenience of our on-site and phone-in registration.

The quality of computer support is a function of the availability of terminals when students come to campus to complete assignments, and reflects the chronic lack of hardware to satisfy student demand. As a result, only 19% of students indicate that terminals are usually available. However, it should be noted that only 40% of the students are required to use computers in their classes.

4.5 QUALITY OF INSTRUCTION

4.5.1 Data Sources, Collection Techniques & Variables

Data related to the quality of instruction are generally collected by surveying the students. Survey data is generally reported in percentages of responses by category. The variables falling into in this category include the delivery style of the instructor, use of classroom equipment (blackboards, overhead camera pad, microphone, telephone, etc.), and the quality of the instruction itself.

4.5.2 Results

It should be pointed out that prior to teaching over the television system all faculty members are provided with individual training sessions and with instructional design support. Faculty members are encouraged to bring sample lectures to training sessions. Lectures are taped and played back for the faculty members, and constructive comments are provided by the instructional designers. If faculty members wish, instructional design consultation is provided to faculty members, along with graphic arts support to assist faculty members in making their graphics appropriate for televised delivery.

It is difficult to generalize the results of analyses in this category. The results are very much instructor-specific. Televised instruction varies in quality, just like regular classroom instruction. However, two things are clear. As a result of the accountability the system imposes (by the availability of the signals at several locations on campus and off campus, as well as the ability to tape record and save class sessions) instructors tend to be well prepared, and to begin and end class sessions on time. When survey results indicate that there may be a problem with an instructor we observe several class sessions (generally at a remote location) before making any determination about the problem. Depending on the nature of the problem, and the personality of the instructor, we attempt to remediate problems on an individual basis.

5. SUMMARY & CONCLUSIONS

The goal of this paper has been to demonstrate the types of data that may be collected, the variables that may be analyzed, and the ways the results of analysis can be used to improve telecommunications programs. The variables discussed in the body of this paper constitute only a small portion of those that can/have been examined. A rough count of the number of variable that have been investigated totals over 75. Only a fraction of those are included in each evaluation, and new items are added as needed to investigate specific problems.

MARKETING YOUR PRODUCTS IN ASIA, THE PACIFIC RIM AND LATIN AMERICA

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1. ABSTRACT

Companies would like to make their products available , on a profitable basis, to the Pacific Hemisphere countries. This can be accomplished through identifying specific markets and locating partners in those markets which will make the products available at competitive prices.

2. INTRODUCTION

This paper covers an approach to the Pacific Hemisphere market that can form the basis for a market entry plan in target countries. It is to used as background for the PTC90 Working Group concerning the subject.

3. MARKET ANALYSIS

The major markets consist of Japan, Canada, Mexico, Australia and Brazil. Other countries should be identified according to specific products.

3.1 ENVIRONMENT

The environment by country is to be analyzed including political, financial and long term stability analysis. Statistics concerning the development of the computer and telecommunications market are to be obtained.

3.2 PLANS

An operating plan and if possible a strategic plan should be put together by country.

The operating plan should consist of a business plan with forecasts. For preliminary forecasts certain tried and true rules of thumb can apply to obtain product sales estimates in orders of magnitude.

A major concern to obtain the forecasts is the ease of market entry in terms of time and resources.

4. RULES AND REGULATIONS

Each country is unique. What works in one country does not necessarily work in another because of the differences in rules and regulations. Certain key points are to be taken into account in regard to these differences as follows:

4.1 AGENTS

In certain countries agents are a requirement and not an alternative to a wholly owned subsidiary. In other countries it is the easiest way to enter the market. In the majority of cases the agent requires exclusivity.

4.2 NATIONAL OWNERSHIP

In a number of countries if a subsidiary is to be established it must be at least 51% owned by nationals.

4.3 TRANSFER OF MONEY

Certain countries have significant limitations on taking hard currency out of the country in exchange for products. In this case it may be necessary to resort to bartering and the trading of goods for products.

4.4 LOCAL CONTENT

In order to sell in a number of countries the products must contain a certain percentage of local content. This may take the form of components, software and/or assembly work.

4.5 GOVERNMENT APPROVAL OF PLANS

There could be a need to have a companies long term plans for entry into a country approved by the country government prior to being allowed to initiate exporting of products to that country.

4.6 JOINT VENTURES

It may be necessary to establish a joint venture with a local manufacturer to gain market entry.

4.7 TRANSFER OF TECHNOLOGY

Most countries in the Pacific Hemisphere want the latest technologies. It can be a requirement that in order to market products in a country that licensing agreements including transfer of technologies and know-how be reached with country companies.

4.8 CERTIFICATION/HOMOLOGATION

This is by far the major hindrance in selling products once the business issues of market entry have been overcome. All telecommunication and computer products must be tested and approved for use prior to being sold and attached to the networks.

4.9 STANDARDS

The country standards in telecommunications must be adhered to and normally are tested to as a subset of certification.

4.10 SAFETY

Other types of criteria must be met by the products which include approvals through testing for product safety and quality.

4.11 BIDS IN THE LANGUAGE OF THE COUNTRY

Bidding in the language of the country should be obvious. However, there have been cases where U.S. companies have bid in english when it was not the national language of the country while their competitors bid in the national language.

5. NON-TARIFF TRADE BARRIERS

A number of countries institute non-tariff trade barriers through the following examples:

5.1 CHANGES IN NATIONAL STANDARDS

Changes in standards is a traditional method of control over foreign imports. A slight modification to a standard will cause the import to non-conform, while those of local companies will, since the companies were well aware of the change and have implemented in their products.

5.2 TELECOM CERTIFICATION

In a number of countries local manufacturers go through a much simpler certification procedure then do their foreign competitors. In addition manufacturing facilities must be inspected by the government regulators at the cost of the manufacturer. This increases the cost to the foreign company above and beyond that of the local competitor.

5.3 NOT RECOGNIZED AS A LOCAL COMPANY

Although a foreign company may have a subsidiary incorporated in a country, that subsidiary is still treated as foreign unless it is 51% or more owned by nationals. The foreign company, although it has offices and manufacturing facilities in a country, cannot participate on an equal footing with local companies. This excludes them from being, for example, a voting member on a national standards committee.

5.4 PATENT PROCESS

In some countries the patent process is simple and faster for national companies. In certain instances it can take a foreign company over six years after filing to obtain approval.

5.5 NO COPYRIGHT PROTECTION

Most countries do not have computer chip and software copyright laws such as has been implemented in the U.S. National competitors can copy the U.S. manufacturers chip logic and software and compete with the foreign company in their own country.

5.6 DIFFERENT APPROVAL PROCEDURES

As with certification the approval procedures to meet electrical and safety standards and regulations can follow two tracks, an easier one for the local manufacturer and a more difficult track for the foreign manufacturer.

5.7 RULES AND REGULATIONS

Laws relating to business and the rules that apply to business conduct differ. Minor modifications to such laws can be made to favor the national company.

6. U.S. SUPER 301

Super 301 is the 1988 Omnibus Trade and Competitive Act supported and implemented through the U.S. Trade Representative.

The Act is to protect U.S. companies from unfair trade practices. Initially Japan, India and Brazil were cited as possible violators.

The Act allows the President to have the ultimate discretion in imposing sanctions against the violators.

Once potential violators have been identified trade negotiations begin. If there is no satisfaction as a result of the negotiations sanctions can be imposed.

Unfair trade practices can include non-tariff trade barriers.

7. PATENTS

There is money to be made in the licensing of patents and know-how.

The U.S. treats all filings the same whether they are filed by U.S. owned or foreign owned entities. Foreign entities are beginning to take advantage of this environment. For example in 1988 foreign patents made up 48% of all patents filed in the U.S. with Japan filing the most of all foreign countries.

As mentioned in the section discussing non-tariff trade barriers other countries make it difficult for foreign entities to obtain patents.

It is obvious that patents and uniqueness of product allows for successful entry into foreign markets and that patents are becoming a powerful tool in competing for those markets.

8. RECOMMENDATIONS

In order to market to the Pacific Hemisphere countries the following are recommended:

1. Find an experienced international executive to manage the sales and marketing.
2. Develop a short term business and marketing plan.
3. Target one country in one region.
4. Make an in depth analysis of local agents and possible joint ventures.
5. Focus on a specific product line. Do not try to market all products.
6. Use the selected agent or joint venture partner to obtain product approvals and to analyze the market.

7. File patents to protect the product line.

8. Establish a licensing program for your patents and know-how.

9. CONCLUSION

This brief paper covers the major points to be considered in marketing to the Pacific Hemisphere countries. It is obvious that it only covers the surface. Each major category of this paper must be addressed in depth once a company becomes serious in venturing into new markets such as those made up by the countries encompassed by the PTC.

NETPLAN (C), A NETWORK PLANNING COMPUTER PROGRAM

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1 - ABSTRACT

NETPLAN is a set of 48 sequenced computer programs, developped by Mario Pietrogrande over a period of eight years and continuously refined, designed to optimize - tecnically and economically - the gradual conversion of telephone networks from analog to digital technology and the planning of fully digital voice and data networks.

2 - BENEFIT of NETPLAN

The use of NETPLAN by telephone companies - particularly in developping countries experiencing high annual voice and data traffic growth - can result in significant financial, operational, public relations and economic benefits. Financial benefits, because an optimized routing plan reduces the cost of the network conversion and expansion. The number of subscriber connections is maximized. Operational benefits, because the performance and grade of service will be maximized. Public relations benefits because the increase in subscriber connections, the elimination of traffic congestion and concurrent service improvement will better satisfy the users compelling needs. And economic benefits, because of the more efficient utilization of the telecommunications infrastructure, a condicion necessary for national economic growth.

3 - NETPLAN OBJECTIVES AND APPLICATIONS

NETPLAN is a set of 48 computer programs designed to achieve network optimization in a variety of applications such as:

- Large metropolitan network up to 3 million lines.
- Long Distance networks, zonal, regional, national and international.
- Satellite networks.
- Rural networks.
- Private voice and data networks.
- Cellular networks (switching optimization).
- ISDN networks
- Introduction of CCITT #7 Common Channel Signalling System

* NETPLAN's objective is to plan and optimize the structure of a digital network for a period of 10 - 20 years. A built-in program permits to use the Kruitoff alghorithm to evaluate future traffic matrices.

* The NETPLAN computer programs permit to derive and evaluate, for each network configuration and each year selected:

  - the point to point traffic matrices
  - the cost of the network (either new cost or evaluation of existing investment.
  - the corresponding Present Worth of Annual charge (PWAC)
  - the optimum quantity of direct, high usage, tandem trunking and their routing.
  - the overall efficiency of the trunking network.
  - the optimized distribution of tandem and transit traffic.
  - the avoidance or elimination of congestion.

* For existing analog networks, NETPLAN prescribes priority in the digitalization of the transmission media (digital fiber or microwave) and of the tandem transit exchanges over the terminal exchanges and the connecting of strategic transit and tandem exchanges via a high velocity digital transmission ring.

* For networks where existing point-to-point traffic data is scanty or inaccurate, NETPLAN builds up huge traffic matrices based on community of interest factors and traffic per subscriber variance, thus estimating traffic offered over a 10-20 year period.

5

- NETPLAN allows performing sensitivity analyses thru the insertion of imposed conditions. Thus, evaluation of changes in the network configuration or performance can be made in case of inaccurate input data, traffic changing conditions and for predicting traffic distribution assuming one or more nodes go out of service.

- When a new subscriber, or a new exchange, or a new trank is added to the network, mathematically the traffic distribution is modified. NETPLAN is designed to keep the data base permanently stored in the file; Thus, using the sensitivity analyses programs, with a simple change in one or more numbers in the data base the program shows in few minuts how the change will affect the network efficiency.

- NETPLAN requires the participation of the planner who may select as many network configuration and alternatives as he or she wishes and then let the computer evaluate each alternative for every year considered. The computer calculates the trunking, the efficiency, the investment or the additional investment for each alternative considered.

- NETPLAN offers a graphic representation of the network alternatives as well as of the corresponding configurations.

- Purposely, NETPLAN does not indicate recommended locations of the new terminal exchanges based on the theory of subscribers center-of-gravity wire-center optimization. This approach is today superceded both by the use of electronics in the outside plant and by the application of remote digital exchanges units, which drastically modify the economics of distribution cables.

- The NETPLAN programs are written in FORTRAN and COBOL and are driven by a Menu written in DBASE III. Each of the 48 program is subdivided in modules and subroutines. The funcion of each module is clearly explained in the 'origin' text of the program. The 'origin' text of the program is supplied same as the compiler programs. Introduction of new subroutines is simple and does not modify the basic program structure.

- The NETPLAN programs are run on a personal computer with a hard disk. The minimum hard disk memory required for medium application is 10 Mega; for very large application it could be possible to arrive to 20 Mega.

- NETPLAN is the only set of computer programs delivered for the client's 'right of use" both in the compiled language and in the " origin " language, so that it can be later client-modified to cater to forthcoming new technologies.

- NETPLAN is also delivered with complete adaptation to a country's specific telecom environment in terms of technical standards, numbering plan, types of switching equipment currently used in that country, etc., and with the eventual addition of any required programs and subroutines to meet customer's demand.

- NETPLAN is simple to be used. However, it is delivered with complete transfer of know-how during a 2 to 3 weeks in-country training program. All detailed documentation of the programs will be supplied.

- Delivery of NETPLAN includes a three year maintenance by the supply of modifications, improvements, new programs and subroutines, as developed by the author.

- In conclusion, NETPLAN represents a powerful and very practical tool to optimize network efficiency, reliability and grade of service, as well as to save substantial amounts of money in new investments for trunking network and transit/tandem exchanges.

4 - GENERAL DESCRIPTION OF THE NETPLAN PROGRAMS.

The entire sequenced NETPLAN process is guided by a menu. The MENU is subdivided in three parts. Each part requires the introduction of a set of input data and runs a subset of computer programs. The data could be either the 'default data' stored in one subdirectory or new data introduced with an 'edit' program included in the menu.

In the FIRST PART, input data is limited to a list of sites with names, coordi-

nates and characteristics as well to a simplified matrix of present traffic limited to 'geographical' areas. The program uses different subroutines depending on the availability of traffic data; program can reconstruct traffic data when missing or incomplete. The list of exchanges and exchange-units with their parameters, type, numbering, geographical or X-Y coordinates consists in a relatively limited quantity of input data, in as much as only one line for exchange unit.
There is no limit to exchange unit quantity; however the limit is represented by the speed of the computer. A 386 type computer can process the entire set of 48 programs for 250 exchange units (each matrix constructed by the computer has the size of 62,500 members) in less then 2 hours. Input of traffic information, instead, requires a considerable amount of input data because the quantity of records is equal to the square of the exchange units. In the first part of NETPLAN there are special routines allowing the planner to reduce the traffic input data to a maximum of 2500 records for the 250 exchange-unit study. This is very important because all matrices are created by the computer and no human error is introduced.

The NETPLAN programs are designed to minimize the otherwise enormous work of introducing traffic data.

NETPLAN calculates the switching unit-to-switching unit matrices of traffic for three future years, based upon whatever traffic data is available to start.
NETPLAN computes the complete matrices of community of interest factors, extends the matrices to future exchange units, includes the modifications due to existing congestion, includes factors estimated on the modification of traffic per subscriber, and finally derives the future matrices of traffic based on traffic offered and not on the actual flow of traffic. Therefore, NETPLAN indicates where and when traffic congestion occurs, where the congestion is originated and how it is extended to the network. The first result of NETPLAN calculation is the modification of traffic routing, hence the elimination of all congestion with no (or very limited) new investment in tandem exchanges.

In the SECOND PART, the subset on NETPLAN programs requires input data from the planner on his routing criteria and basic network configurations relative to all the network alternatives to be explored.

Additional input data required is the definition of each alternative, the various subdivision in tandem areas in order to give the necessary informations to the computer when and where select a direct route, a high usage route or a route via tandem/transit.
The second part of NETPLAN runs for every alternative and the MENU storages all data relevant to each alternative in a separate file.

In the THIRD PART of NETPLAN the quantity of point to point trunks required is optimized for every alternative.
Additional input data is to be introduced either from the 'default data' of from the 'edit' program included in the menu: the unit cost of transmission media, such as cable, fibers, microwave, digital terminations, multiplexers, analog to digital converters and signal converters.

Once the optimization of the trunking network is completed, NETPLAN calculates the cost of each trunk group: as an additional investment or as a value of equipment already installed or both. The calculation is extended to the Present Worth of Annual Charges, and the calculation is extended for every alternative to each of the three years under consideration.

The third subset of programs is extremely complex. Direct trunking is selected either analog or digital, in case the traffic exceeds certain values, or when the traffic is between remote switching units and the homing base unit, or when different units of the same exchanges are located in the same premises. The characteristics of originating and terminating exchanges are examined in this calculation and digital traffic is separated from analog traffic.

High-usage formulae are quite complex and are perused if the traffic is originated in an exchange having common control capability. In this case the programs compute the quantitites of direct high-usage trunks versus routing of the traffic via tandem, comparing the relative costs. This method is usually referred to as 'Economic Erlang' calculation.

The programs include twentyfour cases of trunk selection using nine alghorithms inserted automatically by the computer in order to rigorously calculate the quantity of trunks corresponding to each traffic modality, including peakedness factors and overflow traffic. The results(for every network alternative and for every year considered) are summarized

in a table whith the characteristics of the network in terms of quantity of direct trunks, high usage trunks, transit or tandem trunks, and trunks between tandems or transit points.
Each table includes the efficiency of each group of trunks, in Erlangs per trunk in the peak hour, the cost of the investment, the PWAC and the total length of the network.

An exemple of this summary report is in figure 1.

The program, if requested, prints the complete list of trunking facility with indication of the most economic transmission media, unless the transmission media is existing. In this case the cost could be limited to the eventual converters or could correspond to the relevant investment.

Figure 1 **URUGUAY - ESTUDIO DE OPTIMIZACION DE LA RED DE MONTEVIDEO**

Ano de referencia 1994 **Preparado el dia 21/08/89**

1994 DSTOS DE TRAFICO Y TRONCALES PARA LA ALTERNATIVA HHH
ESTA ALTERNATIVA CONSIDERA EN AL ANO 1994 (PRIMERA ETAPA):
EL ANILLO DIGITAL: PASO MOLINO, AGUADA, UNION, CORDON, CENTRO

TRUNKING SUMMARY

	ONE WAY TRUNKS			TWO WAYS TRUNKS			
	DIRECT TRUNKS	HIGH USAGE TRUNKS	TERMINAL WITH TANDEM TRUNKS	TERMINAL WITH TERMINAL TRUNKS	TERMINAL WITH TANDEM TRUNKS	TANDEM WITH TANDEM TRUNKS	TOTALS
Quantity :	5047	5963	3579	23400	11460	2130	51579
Traffic (E) :	3735.23	4790.60	2814.85	18592.99	9481.99	1718.41	41134.05
Average % Traffic per Trunk :	74.01	80.34	78.65	79.46	82.74	80.68	79.65
Total Investment: ($x1000)	3227.0	5335.5	3012.1	4835.6	1683.4	412.7	18506.37
Annual Charge ($x1000) :	287.1	470.4	267.5	408.3	141.8	34.4	1609.5
Average AC/trunk ($) :	56.9	78.9	74.8	17.5	12.4	16.1	31.2
Average AC/Erlang ($) :	76.9	98.2	95.0	22.0	15.0	20.0	39.1
Total CKT.KM :	22779	57886	21289	145454	52840	14596	315276

Total Value of the Network - $ x 1000	- Tandem Switching	2159.13
	- Trunking	18506.37
	- Total	20665.50
Annual Charge of the Network-$ x 1000	- Tandem Switching	259.10
	- Trunking	1609.53
	- Total	1868.62

Annual Charge of Total Network Averages 9.04 % of the Investment.

5 - SUMMARY OF NETPLAN USAGE

Argentina (1980) - Buenos Aires
- 2 million lines

- The first PCM ring in the world is designed and optimized. Its introduction proves for the first time that trunking digitalization is much more cost effective then terminal exchange digitalization.
- The introduction of digital tandem exchanges and 140 Mb/s optical fiber transmission solves critical overload and speech level problems in a large metropolitan area throughout all the network.
- The digital overlay network is designed and optimized but its implementation is postponed due to contingent national resources limitation.
- Savings realized in the range of over US$ 100 million

Taiwan - (1986) Taipei metropolitan area
over 3 million lines

- The digital fiber optic ring linking 8 new digital tandem exchanges is calculated and optimized. Digitalization of the trunking network of the city reaches 45 % while the digital terminal exchanges connect only 3 % of the subscribers.
- The overlay digital network is configured and optimized one year lather.
- The existing congestion is totally eliminated.
- The overall traffic flow efficiency is elevated from 54 % to 78 %.
- 20,000 existing analog lines (inactive because of limited traffic capacity) are re-activated.
- Saving realized: in the range of US$ 50 million.

Dominican Republic (1987) - Santo Domingo
- 350,000 lines

- The digital optical fiber ring is introduced and the network design optimized, achieving connection of all exixting exchanges to the digital ring's exchanges.
- Economic optimization is achieved with 45 % network digitalization
- Savings realized in the range of US$ 2 million

France - (1988) National Cellular System

- Optimization of the voice and data network composed by the connection of all mobile digital switching exchanges with 550 cell sites interfacing the public switched network.

Uruguay - (1989) - Entire country
over 700,000 lines

- Optimization of the Montevideo Metropolitan network demonstrating that a PCM ring among 5 digital exchanges (already installed) will create a traffic flow efficiency 15 % above the value calculated with a single tandem with almost the same investment.
- Planning for a doubling of the subscribers in three years (1990-1992), preventing congestion and minimizing costs.
- Simplification of the long distance network hierarchy with a saving in future investments of over US$ 11 million.
- A study of the international traffic has shown the limit between the convenience of direct satellite circuits versus the concentration of transit in few countries where most traffic is terminated.

6 - FURTHER INFORMATION ON NETPLAN

A netplan manual, explaining in detail the programs with their sequencing, and offering examples of network planning is available for distribution at the PTC Working group on January 16th, 1989.

Additional copies may be requested via the Pacific Telecommunications Council, or directly to:

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Overview of an Electronic Network in North America

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ABSTRACT

The National University Teleconference Network (NUTN) is a consortium committed to providing an efficient, electronic means of exchanging information between colleges and universities and their constituencies. NUTN serves the teleconferencing needs of higher education, and, at the same time, brings the current thinking and problem-solving capabilities of its member campuses directly to the business sites. To institutions outside North American, NUTN offers access to the higher education community through its network of approximately 300 member institutions and is anxious to forge new linkages.

"Technological innovation consists of three stages linked together into a self-reinforcing cycle. First, there is the creative, feasible idea. Second, its practical application. Third, its diffusion through society."

Alvin Toffler

Who are we?

The National University Teleconference Network (NUTN) is a consortium committed to providing high-quality, telecommunications-related services in a cost effective manner to colleges and universities and to appropriate external groups who wish to interact with higher education. The "creative, feasible idea," Toffler's first stage, had its genesis in an informal discussion among deans of continuing education on the rapid development of satellite teleconferencing and its benefits and advantages to higher education. The concept has proven to have unlimited potential as a communication vehicle which helps institutions of higher education better serve their constituencies.

Toffler's second stage, "its practical application," is well under way. Diverse applications are appearing in every area of society: academia, business and industry, religion, government agencies, etc. The communications technology is, indeed, changing the face of education. It has been said that "the Ivory Tower is sprouting satellite antennas" as college campuses across the nation add this delivery system to improve their services to students, faculty and staff, and the public at large. State departments of education and state and regional county cooperative extension offices, to name only a few, are applying the new technology. Electronic communications is a significant new industry, and the proliferation of educational applications is causing regulatory and accrediting agencies, broadcasters, equipment manufacturers, systems designers, technical services providers, and other communications specialists to take note. Successful applications (locally, regionally, nationally and internationally) have stimulated new initiatives critical for our "global society."

NUTN was conceived by a group of visionary leaders who were looking for a better way of serving their constituency in the educational environment of 1982 (the situation remains true today) when

1. educational communities were strained for resources ("soft money" was difficult to come by);

2. there was a decline in traditional college and university enrollments;

3. the information explosion was upon us;

4. a profound change was occurring in the way we communicate as a society.

Thus, in July 1982, a group of like-minded institutions represented by entrepreneurial educators agreed to establish an experimental network. Oklahoma State University (OSU) was contracted to coordinate the consortium of 66 institutions of higher education and the Smithsonian Institution. They were trail blazers on this "new educational frontier," endeavoring by the use of electronic and satellite technologies to find answers to some of the questions regarding the proliferation of instructional programs which transcend state boundaries. These questions have continued to plague educators and policy makers..

NUTN is the first and the largest independent network of its kind, transcending the geographical and financial restraints which once limited information sharing among colleges and universities, professionals and the public. Capable of reaching the remotest parts of the country as well as major metropolitan areas, NUTN's member institutions use audio, satellite video computers and facsimile machines to:

- reach national and international audiences with programs they originate;

- expand continuing education programs, especially for professionals;

- collaborate on instructional, research, and administrative issues;

- provide broader professional development opportunities for faculty and staff;

- cooperate with private industry and other public and private associations on national educational programs of mutual interest;

- dialogue on national and international societal issues;

- collaborate with other networks to expand the audience for electronic programming.

NUTN serves as a valuable interface between the academic and business worlds. A national network of academic institutions, businesses and industries linked via satellite videoconferencing constitutes a highly responsive communications system. It is the premise of this consortium that the development and the maintenance of highly educated and skilled human resources are of great economic importance.

What are we?

We are a consortium whose members' needs and interests drive the network of over 247 colleges, universities and technical institutions. This is the underlying strength of NUTN. Members participate in the operations of the Network through the Advisory Board and Resource Groups. While the Advisory Board provides direction in the overall development of the Network, the Resources Groups serve as an extension of the NUTN Central Office. Recommendations from both groups are critical in the general network operations and to its future. This structure insures a broader base of support and, even more importantly, draws upon the many skills and talents within the membership. Both groups have been expanded to respond to the spectrum of NUTN services. The Advisory Board, previously limited to academia, now includes representation from business and industry. The Board provides direction as NUTN implements its affiliate service linking industry to a local institution of higher education through a reciprocal arrangement to promote sharing of programming and resources. Likewise, as additional NUTN services are added, appropriate resource groups and sub-resource groups are being developed (e.g., Quality and Standards, Crossnetworking, International, Publications, and Research and Development).

In late 1983, the NUTN Consortium was deemed a successful experiment in cooperation and discussions ensued on finding a more permanent arrangement. Three options were considered. NUTN could:

1. be positioned in the organizational structure of a member university;

2. become a for-profit network;

3. exist as an association.

A significant factor in selecting the option was the availability of financial resources. NUTN was developed through membership fees, although program fees are gradually becoming a substantial source of revenue.

By the mutual agreement of the membership, NUTN became a unit of Oklahoma State University (OSU) on October 1, 1984. This move enabled NUTN to operate more economically (a factor critical to an embryonic organization) because of ready access to the extensive support system of a major university. The Network's services also enhance OSU's already highly developed telecommunications system (a $7 million operation). The OSU Administration is committed to utilizing the new communications technology creatively for higher education, and it supports the concept of NUTN. OSU's support, both moral and financial, has been a significant factor in NUTN's success.

Very briefly, NUTN operates in the following way. One institution develops a quality program on a timely subject utilizing skilled presenters conveying the most current information and offers the program to other institutions and organizations throughout the country. Receiving sites pay a fee to the originating institution. The NUTN Central Office coordinates those efforts and the result is that the cost for individual participants is nominal. (See Schematic of NUTN's Programming and Services, Figure 1.)

This consortium which developed out of member initiatives claims with pride the following characteristics and accomplishments:

1. NUTN is the largest campus-based teleconference network in North America. As of December 1, 1989, NUTN had 245 members. Of this number, 144 were four-year institutions and 103 were junior, community and technical colleges.

2. NUTN has created an international division for the world-wide exchange of information.

3. NUTN markets to both member and nonmember sites. We regularly market to over 500 potential members. Since the Network began, over 1,00

colleges and universities have received NUTN programming for their constituencies. One program reached approximately 3500 participants.
NUTN is in the process of creating and maintaining a data base on the telecommunications capabilities of all (approximately 3500) institutions of higher education in the United States.

4. NUTN is expanding cross-networking opportunities nationally and internationally. Cooperation among networks is essential to provide cost-effective programming. The growth of dedicated viewing sites is accelerating rapidly. Elliot Gold, President, Business TV, Inc., states that in December, 1986, there were 5400 reported satellite receive sites (located primarily in educational and health care institutions, and business and industry - no public sites, such as hotels, were included). By March, 1987, there were 7,000. Gold predicted 10,000-11,000 sites by the end of 1987.

5. NUTN serves as the secretariat for the newly-formed Foundation for International Tele-Education (FIT), an international umbrella organization composed of various groups seeking to use electronic technology to promote education on a global scale.

6. Member institutions represent a huge reservoir of programs. Colleges and universities have long been a source of knowledge and services to the community. NUTN is providing an alternative way to deliver these services.

7. NUTN is developing broader and improved services for business, associations, government agencies and other educational institutions through its "affiliate" service. Institutions willing to assist these groups in providing lifelong education are experiencing financial benefits.

8. Almost all member institutions have their own downlink equipment and over sixty are capable of originating programs. An increasing number have their own uplink equipment.

9. Member receive sites generally are staffed with coordinators who are experienced in marketing and facilitating teleconferences. These professionals enhance the national programs by providing the client services necessary to assure success on the local level.

10. NUTN has an experienced Central Office staff to coordinate the resources within the membership, to facilitate networking, and to provide consultation and training in receiving, marketing and originating live interactive satellite programming.

11. Programming, the heart of NUTN, is developed by both member institutions and external groups whose interests are congruent with the Network. We have offered close to 400 videoconferences (all noncredit to date). Eighty-nine programs were offered in 1988-89.

12. NUTN is coordinating industry-wide efforts to establish programming quality and standards. In the meantime, program standards are encouraged through carefully designing announcements to detail accurately what the receiver can expect, and by thorough monitoring, evaluating and consulting.

13. The NUTN Central Office encourages the membership to design and implement research projects in the area of electronic distance education and it offers the Network as a laboratory for such research efforts, where appropriate.

14. The NUTN Central Office provides practical training opportunities for both undergraduate and graduate students interested in management, communications or distance education.

15. Members reduce the risk of trying new technologies by networking with other experimenters. This will result in greater integration of the communication technologies.

The uniqueness of each campus contributes to a rich teleconferencing environment. To NUTN's advantage, the satellite footprint is all inclusive - it reaches all types of institutions: public and private, research-oriented and technically-oriented, rural and urban, large and small. Each institution's unique characteristics result in the need for diverse services from NUTN to help serve their constituencies.

The common thread which runs throughout the Network is that each member institution is an accredited institution of higher education. This factor alone defines many similarities and provides a framework on which to develop policies. It is clear that the framework alone is not enough to support an administrative structure which is flexible enough to accommodate our diverse membership but strong enough to hold the consortium together. But combined with the members' desire to cooperate and build partnerships - anything and everything is possible!

This diversity presents even greater challenges when working with non-academic groups who have little patience with complex and time-consuming procedures mandated by our academic nature.

Ernest A. Lynton, in The Missing Connection Between Business and the Universities, discusses this area thoroughly in regard to his investigation of deterrents to successful collaborations between business and academia, especially as they relate to the development and maintenance of highly educated and skilled human resources. He maintains that academia will be the loser until some changes are made. He states that corporations expect a far shorter response time from colleges and universities than is now possible under the usual academic program review and approval procedures. He also reminds readers that "colleges and universities are generally inflexible and unresponsive, and tend to be too abstract and too theoretical." Taking the path of least resistance, corporations, for the most part, provide their own training. Many are even establishing their own colleges which, in turn, have been approved by state coordination boards.

We believe that NUTN members, working together and learning from each other, can become the missing connection between industry and academia. We can identify many of industry's training needs, secure the talent from member institutions, and oversee the development, production and broadcast of the needed programs. For this to happen members must work consortially since their individual efforts affect each other so dramatically.

So, what are we? An expanding national network of visionary leaders in higher education teleconferencing. Consortially, we are leveraging communication technology to provide a timely, cost-effective communications alternative for improved service to our constituency. The consortium is providing members with a competitive edge as we move into the 21st century - just 10 years away.

Where Are We Going?

Toffler's third stage in technological innovation, "its diffusion through society," will have an enormous impact on the future of NUTN. Most societal indications support the belief that the use of satellite communications in academia will continue to mushroom nationally and internationally. Education delivered electronically has grown to such dimensions that it regularly commands congressional attention.

The next five years for NUTN will continue to be challenging, yet full of promise. We will develop new and improved services to meet the in-house needs of academic institutions as they strive to integrate telecommunications more effectively into higher education, and we will forge new alliances with outside groups (nationally and internationally) to help higher education better serve their constituencies. Thus, our objective is two-fold: to continue to refine and expand present services, and to develop and implement new initiatives which respond to the trend toward more and better utilization of telecommunications for global delivery of information and instruction in both the credit and non-credit areas.

NUTN members ARE the Network. Activities are membership driven. NUTN's ongoing projects include:

1. expanding the market for member programs by energetic marketing and cooperative arrangements with other networks;

2. providing more training in receiving, marketing, and originating videoconferences;

3. defining and enforcing program standards;

4. developing and implementing incentives to member originators who offer programs through NUTN;

5. securing outside funding for program development;

6. seeking more cooperation from top administrators to provide local support and recognition for entrepreneurial educators;

7. capitalizing on NUTN's strength in numbers to secure the best external programming available;

8. providing input to equipment manufacturers to help assure that technical design is application-driven;

9. expanding NUTN's visibility, especially to potential program users;

10. experimenting with new applications, including credit and international programming, to identify those best suited for distribution through NUTN;

11. encouraging research designed to enhance teleconferencing interactivity;

12. identifying additional services to serve the diverse needs of the members.

Institutions of higher education all over the world are struggling to adjust their structures and priorities in order to respond to the changes taking place in society. NUTN finds itself in the center of this ferment in higher education. As a network, it is strategically placed to serve as a "hub" for activities, providing the means by which institutions of higher education can help each other.

Each segment of the higher education community needs to have linkages with the other segments and these linkages need to be across geographic boundaries as well as across organizational frontiers. (See Schematic of the Global Networks, Figure 2.) To institutions outside the United States, NUTN offers access to the American higher education community through its network of 247 member institutions. To its members in North America, NUTN offers news and announcements of programmatic activity in other countries. We urge you to join with us in forging these new linkages.

Dr. E. Marie Oberle
Director
National University
Teleconference Network
Stillwater, Oklahoma, U.S.A.
(405) 744-5191

Schematic of NUTN Services

Sources of Programs & Services

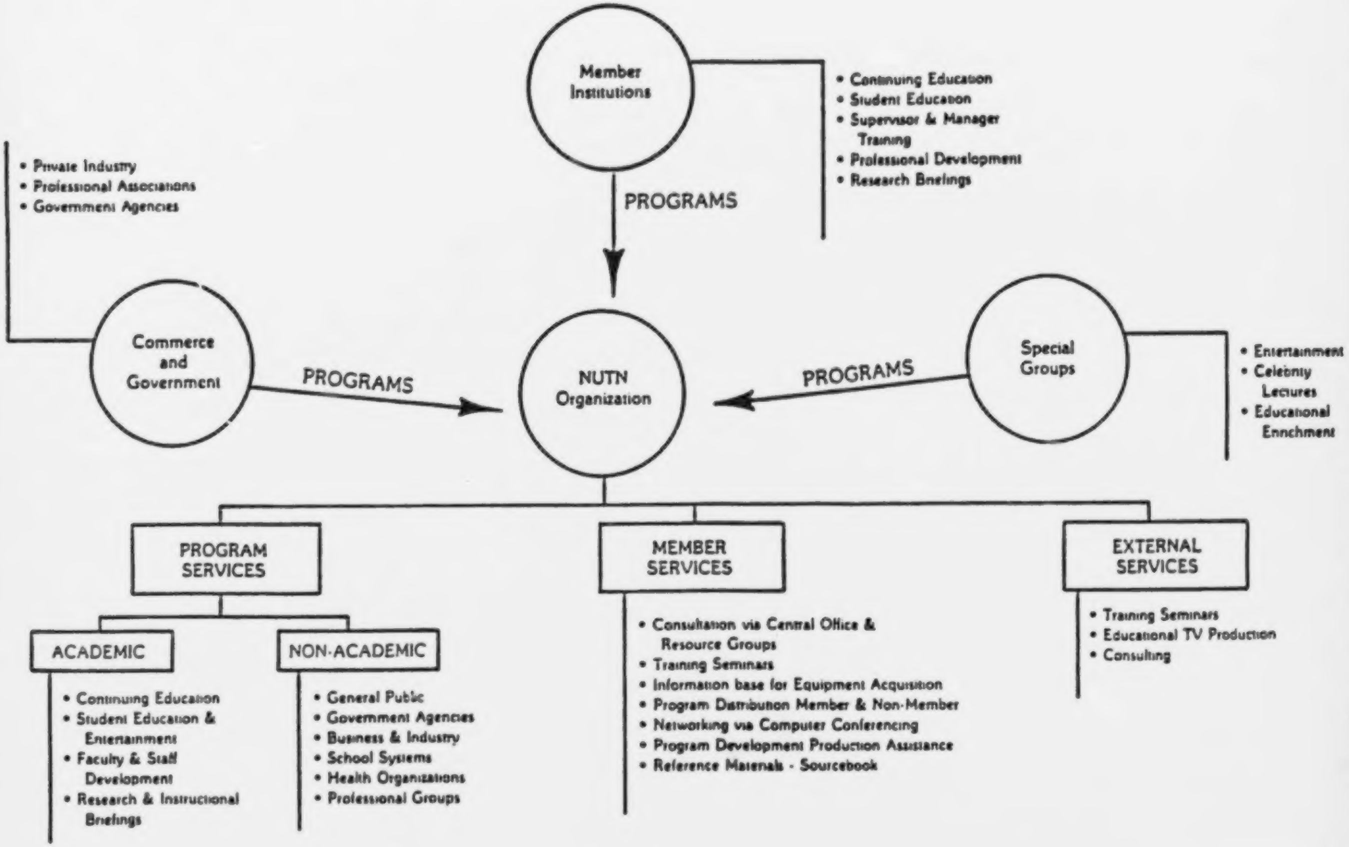
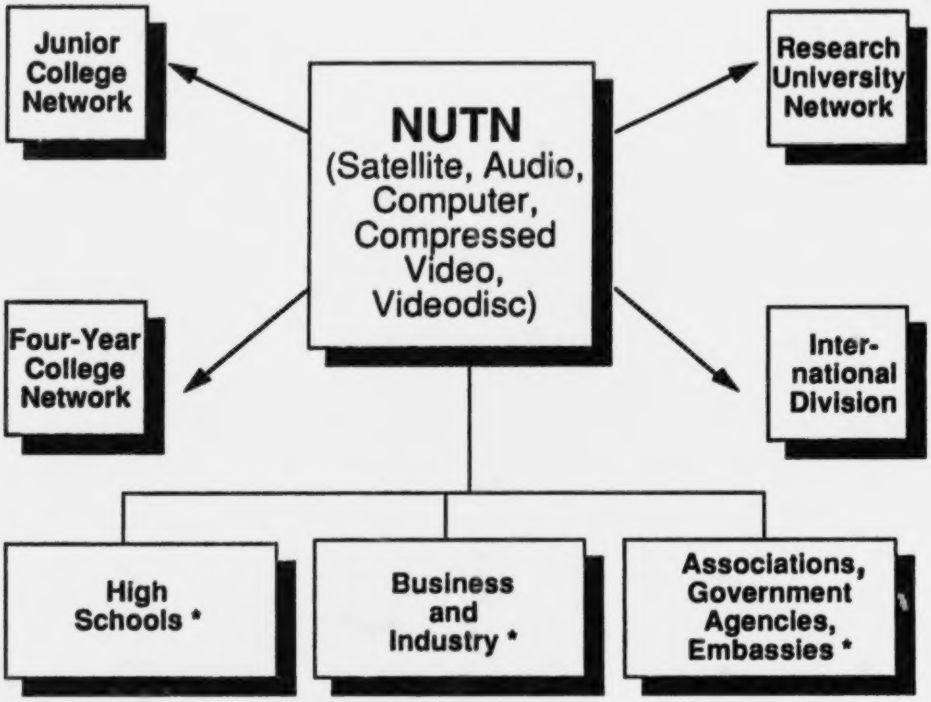

Member Institutions
• Continuing Education
• Student Education
• Supervisor & Manager Training
• Professional Development
• Research Briefings
PROGRAMS
• Private Industry
• Professional Associations
• Government Agencies
Commerce and Government
PROGRAMS
NUTN Organization
PROGRAMS
Special Groups
• Entertainment
• Celebrity Lectures
• Educational Enrichment
PROGRAM SERVICES
MEMBER SERVICES
EXTERNAL SERVICES
ACADEMIC
• Continuing Education
• Student Education & Entertainment
• Faculty & Staff Development
• Research & Instructional Briefings
NON-ACADEMIC
• General Public
• Government Agencies
• Business & Industry
• School Systems
• Health Organizations
• Professional Groups
• Consultation via Central Office & Resource Groups
• Training Seminars
• Information base for Equipment Acquisition
• Program Distribution Member & Non-Member
• Networking via Computer Conferencing
• Program Development Production Assistance
• Reference Materials - Sourcebook
• Training Seminars
• Educational TV Production
• Consulting

Figure No. 1

Global Network


Junior College Network
NUTN (Satellite, Audio, Computer, Compressed Video, Videodisc)
Research University Network
Four-Year College Network
Inter-national Division
High Schools *
Business and Industry *
Associations, Government Agencies, Embassies *

* Not members of NUTN, but can receive NUTN programs and services

NUTN
National University Teleconference Network

Figure No. 2

RURAL RADIO TELEPHONE
"THE LAST MILE"

W. I. THOMAS, PRESIDENT
TELEMOBILE INC.
TORRANCE, CA

Radio is now widely used in developing and developed countries alike for reaching "the last mile" or to 100 miles to provide telephone service in sparsely populated areas. The service provider can now get proper return on investment in rural telephone service rather than subsidizing for social benefit. With the cost of copper going up and the cost of radio going down even in developed countries, the cost of running one mile of wire to a single rural subscriber's residence is more expensive than providing radio as a phone link.

Telemobile, since 1963, has been providing equipment to the rural telephone market. With the recently enacted BETRS Program in the United States, Telemobile has now provided multiple channel off-the-shelf phone links that telephone companies and distributors can stock, and non-technical personnel can install to meet the immediate needs of phone service in virtually any location throughout the world. The equipment is designed to interface with satellite links, microwave links and wirelines. It is compatible with the latest digital networks as well as the older styled rotary phone systems.

RADIO PHONE - THE LAST MILE

Telephone companies throughout the world are finding radio phone link as the most economical and reliable solution for reaching the "last mile" or the "last 100 miles" in providing phone service to rural areas.

All the major telephone companies in the United States have determined that going one mile off the main phone line can now be done more economically and reliably with the new Telemobile single subscriber phone links than the cost of installing and maintaining wireline service.

Cost is not the only factor in determining how to provide phone service to rural areas. Geographic conditions such as going through inhabited forests, mountains and across bodies of water, make radio the only reliable solution for phone service in remote areas.

Countries with insurgency problems use radio phone links to more easily maintain service without interruptions. Remote locations can be easily changed and installed quickly when the need requires.

The Bangladesh Telephone & Telegraph Board found that the annual flooding problem in their country has made it impossible to maintain telephone poles or underground cables. They have turned to radio as the only practical solution for reliable phone service.

India has an ambitious program to provide phone service in every one of their 500,000 villages by the year 2000.

Pakistan is already well into a similar program of utilizing radio to provide telephone service to all of their remote villages.

Cable & Wireless has recently provided the residences of Falkland Islands with telephone service to all areas utilizing the Telemobile multi-access point to multi-point systems all linked together to the central office via microwave backbone link.

The list seems endless, but yet the telecommunications industry is in the race for technology while the service providers themselves are still looking for the answers to the "last mile".

Communication is a wonderful thing for those of us who live in the cities. We take telephone service for granted while there are those in the remote parts of the world who think it is a luxury that they will never be able to afford in their lifetime.

One of our Telemobile engineers was recently overwhelmed with gratitude of the people in a small community of Indonesia when recently completing a Telemobile Rural Telephone installation that enabled these people to call their relatives in Jakarta.

It is quite logical for the telecommunications industry and service providers alike to focus on the needs of major metropolitan areas. This is where they have the greatest demand for voice and data communications. With the concentration of users the return on investment is much more attractive to both equipment providers and service providers.

The radio phone link enables service providers to bring basic service to the rural areas that will interface with their modern equipment in the central hub and yet keep their initial investment cost low. This allows their return on investment to be immediate and yet offer the much needed service to the rural areas.

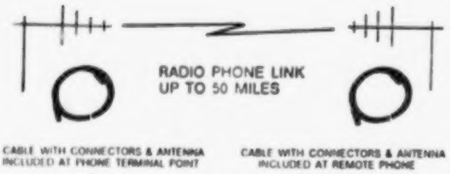
In the United States the Rural Electrification Administration was established back in the '30's to provide low cost funding not only for rural electrification but also for providing telephone communications to the rural areas. The telephone companies are provided low-cost long-term loans for purchase of radio phone links. With the minimum maintenance cost on such equipment, the return on investment is immediate. The subscriber pays a reasonable monthly fee that does not require subsidization.

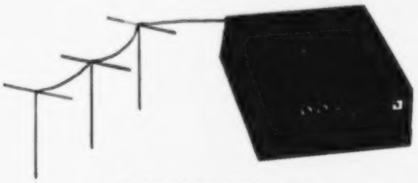
There are different types of radio phone links that are offered. Following are examples systems from the basic single line, single subscriber with an initial cost as low as $2500 up to the point to multi-point systems such as the Telemobile MRRT Random Access trunked terminals.

Fig. 1 shows a complete single line, single subscriber system consisting of a DC operated terminal interconnect unit with associated cable and antenna plus a remote terminal unit with its associated cable, antenna and phone instrument.

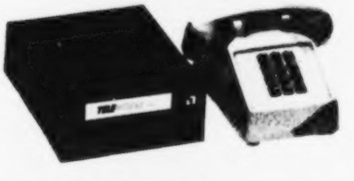
The choice of frequencies varies from 66 to 520 MHz, depending on the type of terrain and the frequency allocations that are available. Telemobile offers a complete range of 2 to 100W units in all frequency ranges

SINGLE SUBSCRIBER TELEPHONE RADIO SERVICE
RURAL TELEPHONE EXTENSION BEYOND THE PHONE LINE


RADIO PHONE LINK
UP TO 50 MILES
CABLE WITH CONNECTORS & ANTENNA INCLUDED AT PHONE TERMINAL POINT
CABLE WITH CONNECTORS & ANTENNA INCLUDED AT REMOTE PHONE



TRI TERMINAL PHONE LINE
INTERFACE (12VDC)



SUBDT REMOTE (12VDC) WITH DESK PHONE

Fig. 1

Fig. 2 shows a remote subscriber station that would have the entire unit with batteries and solar charging system installed in a weatherproof enclosure on a mountaintop for line-of-site back to the terminal interconnect unit. A wire pair is then run down the backside of the mountain for up to a mile to where the location of the phone instrument will be installed for convenient use by the subscriber. If properly installed, the mountaintop remote station is self-powered with solar energy and needs no maintenance whatsoever for over one year.

REMOTE SUBSCRIBER STATION

SUBDT REMOTE PHONE (12V DC)

Operates from AC-DC converter or directly from battery with solar power charging system as shown to the right. Phone itself can set on top of subscriber radio package as shown above or be up to 1 mile away (connected by regular 2-wire phone line). Housing at right holds both batteries and radio unit in locked weatherproof steel cabinet.

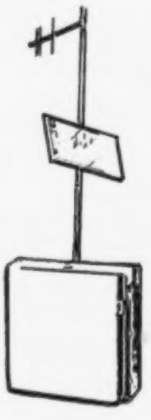


Fig. 2

Fig. 3 shows the same outside enclosure with solar panels mounted on the phone pole itself with the terminal interconnect unit and battery enclosed on top of the phone pole. This type of installation is used to send a single line up a canyon run for a single subscriber or even utilize an omni directional antenna and provide mobile type phone service for ranching and large farming operation where subscriber phone location will change from time to time.

A single line terminal equipment is configured to connect to any two-wire or 4-wire E&M interface circuitry with provisions to interface to a rotary/pulse or DTMF phone service compatible with the latest ISDN switching requirements for voice or data communications. The range from a single terminal varies depending on the selection of frequencies and power as well as antenna height and gain of the antennas themselves. Most systems are designed for 50 mile point-to-point links from the phone line interconnect point, however, selecting in the lower frequencies such as 70 MHz, the equipment range can be extended easily to a 100 KM or more.

Terminal phone interconnect in weatherproof locked enclosure with batteries, mounted on top of telephone pole. For more distance, antenna can be on push-up mast extended above phone pole as shown. Solar panels to charge batteries in housing are mounted just below antenna on same mast.

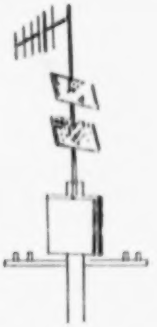


Fig. 3

Fig. 4 shows an illustration of a system when required to reach extended ranges or behind mountain areas. Telemobile provides a full duplex repeater which is 12V powered so that it can also be housed in a weatherproof enclosure with a battery and solar panel kit on a mountaintop with no maintenance requirements. This enables a fixed or mobile subscriber on the backside of the mountain to have full duplex phone service back to the main phone line CO.

REACHING BEYOND MOUNTAIN AREAS

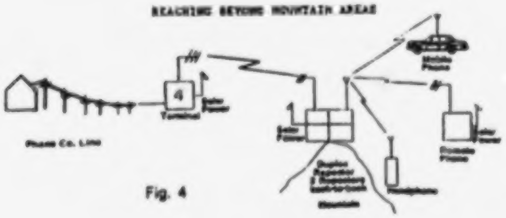

4
Terminal
Solar Power
Phone Co. Line
Mobile Phone
Portable Phone
Mountain

Fig. 4

Telemobile System 99 is a low-cost step up to a village party line system.

Fig. 5 shows a single line overdial configuration that provides one terminal to be connected to an end-to-end line to answer the call and then overdial the extension number of the particular remote subscriber. The modem circuitry provides for busy lockout and call queing so that the old days of your neighbor listening in on your party-line conversation is eliminated.

VILLAGE PARTY LINE RADIO PHONE SYSTEM 99 P

SMALL TOWN PHONE SERVICE FROM TELEMOBILE

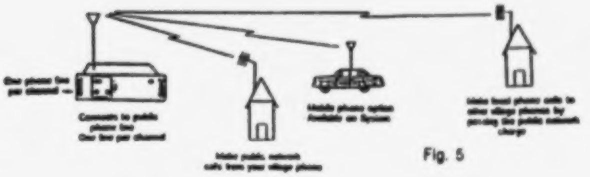
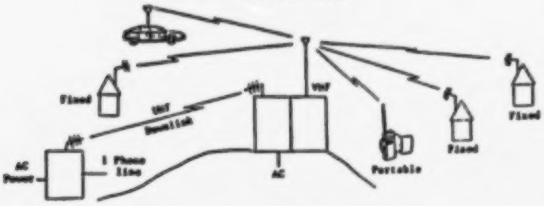

One phone line per channel
Connects to public phone line
One line per channel
Make public network calls from your village phone
Mobile phone option Available on System

Fig. 5

Sometimes the System 99 terminal is located on a mountaintop with a downlink to where the telephone interconnect line is available, and this allows for a maximum radius of coverage to the rural area being served. (See Fig. 5A)

As the service level requires, the terminal is expanded, 1 channel at a time, with no change in the rural subscriber units. The rural subscriber units are already equipped with the 32-channel scanning capability that allows for expansion as the service level requires.

SYSTEM 99PR


Fixed
UHF
Downlink
VHF
AC Power
1 Phone line
AC
Portable
Fixed
Fixed

See Fig. 5A

Fig. 6 shows a 2-channel system with a low-cost PABX unit at the terminal location that allows the local village subscriber to call each other through the PABX without being metered through the public switched telephone network. This allows for costs to be controlled on a local basis for each village area without involvement of the public switched network system.

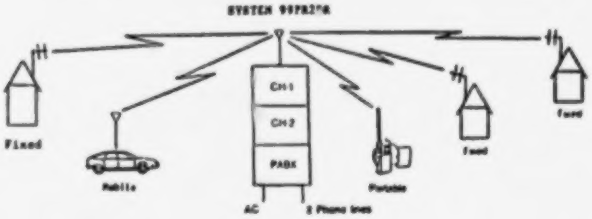

SYSTEM 99PB2"A
Fixed
Mobile
CH-1
CH-2
PABX
AC
2 Phone lines
Portable
Fixed
Fixed

Fig. 6

The point to multi-point terminal, the Telemobile MRRT System, is the latest configuration of modern technology providing a completely transparent linking system to reach the remote areas on a low-cost basis and still allow each subscriber to have a phone number assigned as part of the PSTN.

Fig. 7 shows a 2-channel, 16 subscriber MRRT System that is expandable up to 8 channel, 96 subscriber system only by adding modules on to the basic system.

MRRT SYSTEM PROPOSAL
2-CHANNEL 16 SUBSCRIBER
(Expandable subscribers 16 per step to 96 total)
(Expandable channels 2 per step to 8 total)

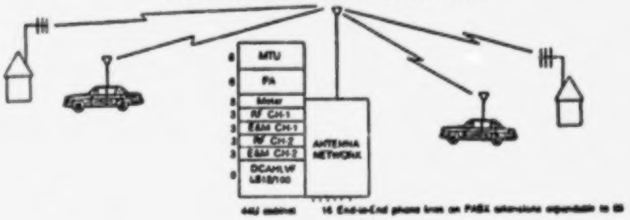

MTU
PA
Meter
RF CH-1
E&M CH-1
RF CH-2
E&M CH-2
DC/AC/LVF
ANTENNA NETWORK

Fig. 7

If the number of end-to-end lines are not available at the terminal point, then a PABX system can be added so that each subscriber has a registered number. The advantage of this system is that all of the billing control is maintained at the central office. The linking to the central office can be by wireline or more probably in the remote areas by microwave link or satellite. Whatever the medium to carry the signal back to the switched network, the MRRT System allows all subscribers to have all of the full voice and data communication services of the existing public switched telephone network (PSTN).

The selection of the system depends on the number of subscribers expected in the first two years of service and the terrain considerations. Whether starting with a single line, single subscriber or a providing service for 96 subscribers from a single MRRT terminal, the cost per subscriber still is below $3,000. This cost in itself makes it more economical even if the radio phone link is used only for the "last mile".

"Market Trading of Orbit Spectrum Assignments in the Space Satellite Industry - Joint Ventures and Acquisitions"

__Background Paper For__
A Working Group at PTC 90
Honolulu, HI

Harvey J. Levin
Professor of Economics
Hofstra University
Hempstead, NY 11550

Is it feasible to trade rights to use orbital slots and associated space satellite frequencies in a market, or quasi-market? How can such rights be delimited today? What is the role of international organs like the International Telecommunications Union, or of national agencies like the Federal Communications Commission, or the United Kingdom's Frequency Planning Organs (FPOs)? What evidence is there that such rights or assignments are in fact now configured, and do indeed exist? And that they are frequently traded in international as well as domestic broadcast or mobile radio services?

Even if viable, and practical, what economic policy or equity purposes would be served by configuring actual markets for transferable, exchangeable orbit spectrum rights or assignments? For schemes where national or international authorities distribute such assignments in a competitive market, or by auctions to the highest bidder? That is, via public, and not just private, auctions? For distributive equity as well as for economic efficiency?

This Working Group will review these and related issues by reference to _de facto_ market-type transactions. I have in mind episodes like (1) the rental of redundant capacity on Telesat Canada's ANIK-C (in 1984). Like (2) Panamsat's acquisition of the Cygnus satellite authorizations after Cygnus had gone bankrupt. Like (3) the creation of PACSTAR as a joint venture between TRT's subsidiary, Pacific Satellite Inc. (PSI), and Papua New Guinea's (PNG) Public Telephone and Telegraph Co. (PTT). Like (4) the further proposed joint venture -- ATLANTIC STAR -- between Hughes Communications, Inc. (providing 70% of the capital), and an Irish telecom company (with 30% of the capital). And like (5) still another joint venture -- JC-Satellite Inc. -- between Hughes Communications Inc. and Japan Communications Inc., where HCI puts up only 30% of the capital, and Japan the rest. Or like (6) the economic inducements Panamsat gave Peru to elicit her role as a foreign correspondent, and hence facilitate Panamsat's access to the orbit spectrum. Or further, like (7) Panamsat's strategy to gain access to the European market via a foreign correspondent like Mercury (domestic subsidiary of Cable & Wireless), or perhaps like British Telecom. Or lastly, like (8) ASIASAT, a newly emerging satellite facility, jointly co-owned by Cable & Wireless, China International Trust & Investment Corp., and Hutchison Whampoa Ltd. (Hong Kong), but where the analogy with the cited cases appears to break down in regard to the orbit spectrum resource.

The most illuminating of these episodes are probably those of ANIK-C, PACSTAR, JC SAT, PANAMSAT-Peru, PANAMSAT-CYGNUS, ATLANTIC STAR, and ASIASAT. Because these are doubtless best-known I forgo belaboring the full details about them in this Background Paper. Rather will I focus instead on the high points, with an even briefer word on INSCOM, and HOME SATELLITE NEWS CHANNEL.

1. __THE CASE OF ANIK-C__

Reference is made here to the RCA-GTE annual payments to TELESAT Canada of US $2 millions to tilt ANIK-C southward for __those companies__' use of certain unused ANIK transponder capacity, at least until Canada might itself need that capacity in its northern regions. Specifically, Canada had announced that it sought to sell some underused ANIK-C satellites launched on earlier assignments. For several years before, those satellites had been subleased in part to GTE and RCA, enabling those companies to operate reliably before their own new equipment was orbited and operating.

Clearly, ANIK-C could not supply any transponder capacity without its own assignments to occupy orbit spectrum (without interference). And clearly, also, when it leases unused capacity or sells it outright, or sells an entire satellite, by implication it is also leasing or selling the buttressing assignment. At least, the transaction necessarily entails a sharing of the original assignment.

On the other hand, the lease/sale of an entire satellite could conceivably entail re-positioning or major geographic moves, and, if so, a different assignment may be needed. But then the equipment might be worth far less (or more) depending on the new market contours. Whereas if the original assignment were used, the sale price would reflect the market it served, as well as the equipment utilized. In either case, the economic value of assignments is clearly suggested, and hence, their tradability in international commerce.

2. THE PACSTAR JOINT VENTURE

Still more vividly, note must be taken of the recent proposed Joint Venture between TRT's Pacific Satellite Inc. and Papua New Guinea (in PACSTAR). There, PNG notified IFRB/ITU two years beforehand, on behalf of PSI, that PSI would build on two PNG orbital assignments giving PNG free domestic circuits in return. In this scenario, the DC entity virtually borrowed an unused LDC assignment to illuminate part of the DC's market. In return, it would pay the LDC in kind with free transponders or reduced-rate domestic circuits, at low incremental cost to the DC firm, once the latter's satellite was in place.

In all such cases, and through all cited mechanisms or routes, one could say that LDCs are already finding ways to virtually lease out, lend, or otherwise trade their orbit spectrum assignments. And do so for (a) a portion of a global consortium's revenues (14% return on investment in INTELSAT); or (b) for a comparable return on regional investment by an ARABSAT, ANDEANSAT, EUTELSAT, etc.. Or do so (c) where individual LDC members may pool their assignments by handing them over to a global or regional consortium, or to a specific Western company (as with PNG and PACSTAR), in exchange for some tangible quid pro quo.

In sum, the advantage to PACSTAR in using PNG's assignment appears to be twofold. First, it would presumably get "better" (less costly) coordination under ITU with joint support and sympathy in the South Pacific. Second, it might thus avoid being thrown into the large pool of applicants at FCC, including proposals for a North Atlantic service. Processing the full queue of all those applications would take a long time, and lots of money. If PACSTAR had to wait its turn on the long queue, it might well have far more trouble in getting its preferred assignment than if PNG had applied for it instead.

In short, the engineering expertise, and intimate knowledge of international regulatory-coordination procedures that PACSTAR brought into the joint venture, plus avoidance of the FCC queue, may all have resulted in important cost-savings. Those were in turn exchanged for some free domestic satellite circuits for PNG. Or stated otherwise, PNG's slot value was seemingly created by international administrative sluggishness and incompetence.

In the PACSTAR Case, then, a U.S. corporation, TRT's Pacific Satellite Inc., wanted to create a system in the South Pacific, and arranged to get its assignment in a then unique way. They could in fact have gone to the FCC and waited in line; or waited instead at the International Telecommunications Union (ITU), or the International Frequency Registration Board (IFRB). But PSI sought to avoid some of those delays by going to a third party with whom they entered into a Joint Venture. That was Papua New Guinea (PNG), or more accurately, its PTT. And PNG became the vehicle for getting the assignment in part, presumably because PNG would not incur the same flak as would a U.S. company's application via FCC -- to the ITU.

Note, finally, that Taiwan will join the PACSTAR joint venture. The project would cost $160,00,000, to be split among participating countries.

The satellites would be located at 167.4*E, to be installed with 24 frequency converters, 4 available for exclusive use by Taiwan in 1993. Furthermore, smaller "lightsats" with 10-12 transponders, are being considered for rapid deployment where a satellite could be ready to launch within 18 mos. PACSTAR would provide international and domestic video, voice, and data service.

True PSI would give PNG one free transponder in perpetuity, and, maybe, the TTCM itself, but not the cost of operating it, where PNG must pay the 12-man crew costs, and other related cost operating costs, and do so for 7 yrs, 12 people, etc.

What would it in any case cost to operate the TTCM for 7 years? Vs. what it would cost to buy one transponder for 7 years? Vs. what it would deprive PSI of to sell its "last" unused transponder at the margin?

3. The PANAMSAT-PERU EPISODE

In this case, the PanAmSat Corporation wanted to provide programming and service of various sorts in the Western Hemisphere, but under FCC rules, and ITU regulations, it could not gain access to the orbit spectrum it needed without a foreign correspondent. That is, someone to communicate with at the other end. Otherwise, the Company would simply get a right it is not permitted to use.

What finally happened as you trace it in the trade press, is that PanAmSat did locate a correspondent, when Peru came forth, and, again, as in the PACSTAR case, she was paid one free transponder per year, in perpetuity. Maybe that transponder was worth $1 or $2 million per year INTELSAT and fiber optic systems planned for region.

4. The PANAMSAT-CYGNUS TRANSACTION

Let me now comment on another, final example. Cygnus and PanAmSat are both satellite companies. On one hand, Cygnus is poised, anxious and authorized to serve over the Atlantic to Western Europe and the mid- East, though with no satellite equipment in orbit. Whereas PanAmSat's hybrid satellite has 24 low-cost C-band transponders which she is already authorized to use, plus another 12 transponders higher up in KU- band, where it is more costly to operate, and where FCC continues to prohibit use.

Actually, therefore, PanAmSat does not at this point have permission to use its KU-band satellite at all. Hence one could say that *they've* got the needed *equipment*, while only Cygnus has the needed *right* to operate in KU, at the same orbital location. So that PanAmSat has the physical capability and the equipment already in place, whereas Cygnus has the right to use the full 24 transponders, or one full satellite in orbit, but lacks the equipment needed to start with. And because starting from scratch now to build the needed bird would simply take too long, Cygnus would never make the deadline anyhow.

5. ATLANTIC STAR

Here the partners would be Hughes (HCI) and the state of Ireland, with the proposed joint venture a quasi-DBS. Ireland's orbit spectrum assignment would presumably be used, saving Hughes time and money compared to what it would have cost had she proceeded through FCC to the ITU. So ATLANTIC STAR seems similar to PACSTAR. In both cases, a large U.S. Corporation (TRT or HCI) contributes capital and know-how to a Joint Venture (PACSTAR, ATLANTIC STAR), where a remote developing island nation (Papua New Guinea), or a small European economy (Ireland), contributes the needed orbit spectrum assignments.

With ATLANTIC STAR, HCI proposed to hold 70% of the investment, and Ireland, 30%. The main use was to be for English or Irish language programs for Europe, the Irish getting in because of dissatisfaction with British plans and activity. But now that the British have approved their own system, the Irish seem to have faded out. So if HCI can get contracts from both the UK and Ireland, that would suffice, and there'd be no need for ATLANTIC STAR.

6. ASIASAT   ASIASAT is a 3-firm Joint Venture, one co-owner being the U.K.'s Cable and Wireless Co.; the second, being Hutchison-Whampoa, an affluent investment house in HongKong; and the third, being one of the Chinese government groups, a subsidiary of Great Wall, called China International and Investment Corporation.

In short, each firm is one-third owner of ASIASAT, while all three, jointly, purchased WESTAR-6 from Hughes Communications Inc. (HCI), which Hughes will reconfigure for use in SE Asia, to be launched by LONG MARCH (the chinese launcher), whose underwriters had owned it for a long time, after which they sold it back to Palapa (HCI) and then to Indonesia. Following that, ASIASAT bought WESTAR-6.

All of this is under technology transfer review under Cocom (viz. the Western allies' review board). Yet the French oppose the whole transaction because Long March competes with Ariane Space. In any case, the launch is scheduled for late 1989.

With the PRC as a joint venturer, then, ASIASAT gets U.S. export licenses for permission to ship its satellites (WESTAR-6) to the PRC for launch on the Great Wall Company's Long March 3 Booster.

China earns hard currency for its launchers to capitalize on orbit spectrum value via ASIASAT'S WESTAR-6. So that China puts capital and know-how into ASIASAT, and, indirectly, launcher service too. Just as PNG and TRT-PSI joined to create the joint venture PACSTAR. Just as, also, the State of Ireland and HCI joined to create ATLANTIC STAR, Ireland contributing the needed orbit spectrum assignments, and HCI the needed capital and know-how.

In any case, ASIASAT made a launch agreement with the Great Wall Industrial reflects China's pursuit of hard currency (just as PNG can collect TRT money for access to its orbit spectrum assignment).

However, ASIASAT also needs US export licenses to ship refurbished WESTAR-6 satellites to Chinese launch sites for LONG MARCH 3. But the US is concerned over technology transfer.

ASIASAT does in any case need ITU approval of British slots for satellites at 105*, 116*, 122*EL. However, it prefers 105*EL.

In short, the launcher's value depends on:

U.S. export licenses and the number of satellites transmitted to the launcher
individual launch costs of some $30,000,000
individual satellite refurbishment costs of same size
individual satellite refurbishment costs of some $30,000,000
individual satellite recovery costs of some $120,000,000

In sum, three joint venturers were co-owners of ASIASAT and:

1) contracted with China's Great Wall Industrial Corporation for launch on Long March 3 April 1990 (for ca $30 m); after
2) they get US export licenses to ship ASIASAT satellites to the Chinese launch site for Long March 3 boosters where also,
3) ASIASAT can buy (and register with IFRB) one of Tonga's 8 slots for a $2,000,000 annual lease fee, or some $16,000,000 per year in lease revenues, or $175 per year for each Tonga resident, equal to some 25% of the annual Tonga government budget. Here, in any case, the UK, for ASIASAT, has applied for 105.5*, 116*, and 122* E, almost the same as the Western slots TONGASAT has tied up (at 105.5*, 115.5*, 121.5*, and 131*WL).

And finally, just as Canada proposes that she and Japan use future Canadian satellites jointly in return for the launch of those satellites on a Chinese H-2 vehicle. The latter, to be sold by a new Mitsubishi launcher organization to market commercial launchers on H-2 vehicles at a price of $110,000,000 each.

As with PACSTAR, then, where PNG's orbit spectrum assignment is her contribution to the PACSTAR Joint Venture, and TRT/PSI's is that of needed capital and know-how, then, so, here, too, China's contribution to the ASIASAT joint venture is that of Great Wall's Long March H-3 booster (with a value of some $30 000,000 per launch), and the other partners' contributions, were those of venture capital and know-how.

Here ASIASAT may use 1 of Tonga's 8 slots, where the UK, for ASIASAT, has applied for 105.5*, 116*, and 122* EL, almost the same as the Western slots TONGASAT has tied up (at 105.5*, 115.5*, 121.5*, and 131*WL)

7. SKY TV-DISNEY CHANNEL

Rupert Murdoch's SKY TV filed a $1.5 billion suit against DISNEY for trying to back out of a European joint venture to deliver its programming to Ireland by satellite. DISNEY also puts "on hold" plans to launch the DISNEY CHANNEL on Luxembourg's Astra Satellite, and SKY is making plans to use a transponder to start a classic movie and arts channel later this year.

Each company is to contribute $75,000,000 to the joint venture. Sky says that it has already spent $500,000,000 on same, but that Disney hasn't reimbursed it yet. And indeed, ignores the Agreement and uses economic leverage to exact unjustified concessions from SKY, and also tries to renegotiate more favorable joint venture terms.

8. INSCOM

China's Great Wall (CGW) and Brazil's Avibras Aerospacial have established still another joint venture -- INSCOM (International Satellite Communications) -- in Brazil. This will compete internationally to offer launch vehicles, facilities, services and earth stations, antennas and satellites. INSCOM will combine China's launch vehicle know-how with Avibras's space tracking and international marketing expertise and will sell to governments and private entrepreneurs world-wide.

INSCOM targets third world countries as the key market for satellite services. The company plans to offer satellites and launchers to groups of poor countries -- such as in Africa -- as a cheaper alternative to French and American services.

INSCOM recently registered its Headquarters location in Lichstenstein because that was a "half-way point between China and South America". A Great Wall official said registration was made there to be more competitive with other countries.

The Agreement grew out of a deal last July in which Brazil and China contracted to spend $150,000,000 to manufacture two satellites jointly. The birds were to be used to monitor crops and map natural resources in China. And the launchers, in 1992 and 1994, were to use CGW rockets.

9. JAPAN VIDEOCIPHER CORPORATION
Still another, joint venture, was formed between General Instruments VideoCipher, C.J. Itoh and Co., and the Century Research Center of Japan. According to General Instruments, the joint venture was aimed to market an enhanced version of its VideoCipher commercial and consumer descrambling systems for satellite transmission of entertainment and private network programming. The Joint Venture, JAPAN VIDEOCIPHER CORPORATION, would be responsible for marketing and distribution of VideoCipher equipment in Japan. It would also establish and operate a satellite TV descrambler authorization center. For its part, General Instrument would contribute system design development, software, satellite uplink scrambling equipment, commercial and consumer descramblers. The contribution would be to the joint venture in Japan.

10. EXPORT LICENSE SUSPENSIONS At any rate, the U.S. State Department has suspended its export licenses for the AUSSAT and ASIASAT satellites still tentatively scheduled for launching on China's Long March rocket. The U.S. has halted all licensing of items on our munitions control list in light of political unrest after Tienamen Square. This move actually angered Australian officials who claim the decision would cost them $120,000,000 to $150,000,000, and prompt search for an alternative launcher.

Japan could in any case be the ultimate winner as U.S. reliability as a supplier declines. State says that AUSSAT has not yet been licensed and that the U.S. ban applies only to the use of China's Long March booster. Furthermore, anyhow, Hughes, AUSSAT's builder, is still allowed to transfer technical data, and to price its program under terms of the ban.

The State Department contends that AUSSAT will be in orbit on time. That it is indeed way ahead of schedule. And lastly, that the U.S. would review the least lethal export license applications first, some time soon. Earlier license suspensions are said to have been for public consumption.

AUSSAT and ASIASAT are in any case to be reviewed for exemption -- though State can't lift suspensions until China returns to normalcy (with greater political stability and the end of executions, etc.).

Hughes is still under contract to supply three birds. Nor has there been any word to discontinue work on two ASIASAT satellites, or on the refurbishment of WESTAR-6. However, ASIASAT's 1990 launch, and its 1991/1992 launches, remain "on hold" until the political situation has settled.

License suspensions will raise AUSSAT and ASIASAT costs significantly if they lead to a decision by either group to back out of a Chinese deal and buy Western launchers. "Terms with the Chinese were at introductory prices and would have cost them (AUSSAT and ASIASAT) less than any other Western launcher," spokesmen said. Hughes, which will be meeting soon with AUSSAT to discuss developments, said the company was not panicked by license suspensions because they would have to last "considerably longer than they have) to date" to affect the launch.

There is, in any case, fear that lower prices would leave the U.S. dependent on Beijing's launches and foreign firms. Furthermore, these low prices are temporary promotional charges only, for Western for-profit firms.

Still another Joint Venture was recently formed to provide the HOME SATELLITE NEWS CHANNEL. NEWS CHANNEL would be a 50-50 joint venture of Viacom Satellite News, subsidiary of Viacom International and Conus Communication. It will market service to local broadcasters, and the Showtime Satellite Network will sell it to home satellite dish owners.

Session 3.1

Satellites For Asia

NOTES

SATELLITES FOR ASIA

John D R Lawrence
Asia Satellite Telecommunications Co. Ltd.
Hong Kong

In April 1990, AsiaSat 1 will be launched by China on the Long March 3 rocket. This satellite will provide domestic telecommunications service to the countries of Asia and will have an impact on the lives of two billion people.

AsiaSat 1 is designed to provide domestic satellite communication services to China, Thailand and Pakistan. This service will also be available for the use of neighbouring countries such as Korea, Hong Kong, Burma, Bangladesh and Nepal. As an independently financed satellite it will provide services to each of these countries on an equal access basis and will be shared by these countries depending on their needs.

Although AsiaSat 1 is a regional satellite it will be providing domestic services and will not be competing with Intelsat for international telecommunications traffic. The satellite's 24 C-band transponders will be leased or sold, to customers in each of these countries. Transponders will be used for many purposes including back-up to national telephone networks, new private network services and the distribution of television programs.

By providing powerful C-band signal to most Asian countries, AsiaSat 1 will be able to develop networks with the lowest cost ground stations. New, smaller earth stations set up for AsiaSat can be used to improve communications between major cities as well as creating new low cost solutions for developing rural telecommunications networks. AsiaSat 1 will also be useful in developing the rapidly growing television broadcast industries in many of these countries.

INTRODUCTION

In April 1990 a Hughes HS376 Satellite will be launched by China on the Long March 3 rocket. This launch will be a victory for private initiative and a milestone in international cooperation.

For a number of years, various organizations from many countries have been looking into the possibility of launching a telecommunications satellite which could be used by many Asian countries. In February 1988, a Hong Kong company Asia Satellite Telecommunications Co Ltd (AsiaSat) was formed for this purpose.

AsiaSat is owned in equal shares by Cable and Wireless plc, the China International Trust and Investment Company (CITIC) and Hutchison Telecommunications Limited, a subsidiary of Hutchison Whampoa Limited. Cable and Wireless has been a world leader in telecommunications for more than 100 years; CITIC was formed ten years ago by the State Council of the People's Republic of China as an international investment company and has since been a profitable success; and Hutchison Whampoa Limited is one of the three largest companies in Hong Kong.

In its first year of operation AsiaSat bought a Hughes HS-376 satellite, formally known as Westar VI, and signed contracts with Hughes Aircraft Company for the refurbishment of this satellite. Hughes was also awarded a contract for the design and construction of the Satellite Control Facility/Tracking Telemetry and Control Station which will be located in Hong Kong. AsiaSat then signed a contract for the launch with Great Wall Industries Corporation of the People's Republic of China and a contract for consultancy with Telesat Canada. By early 1989 the launch schedule was set for April 1990 and I can report that the project is still 100% on-schedule.

THE FIRST ASIA SATELLITE - ASIASAT 1

Built in the USA

AsiaSat 1 is a HS-376, spin-stablized satellite. This series of Hughes satellites has been used successfully by US communications companies and by many national domestic satellite services including Canada, Mexico, Brasil, Indonesia and recently the UK. The Hughes 376 satellites are regarded as the most successful communications satellites ever built. Of the 30 that have been launched, none have failed in operation. The two that failed to achieve geosynchronous orbit, Westar VI and Palapa B2, are scheduled to be relaunched within the next 12 months.

As it sits on the top of the Long March rocket, AsiaSat 1 is two (2) meters in diameter and two (2) meters tall. When deployed in space, it extends to a total height of six (6) meters.

AsiaSat's payload of 24 C-band transponders has been configured into two 12 transponder beams. Each transponder is linearly polarized and powered by an 8.2 watt TWTA to provide a maximum EIRP of 37 dBW.

Launched by China

AsiaSat 1 will be launched in April 1990 on the Long March 3 rocket. The launch site is near the city of Xichang in Sichuan province. The Long March 3 rocket is considered to be one of the world's most reliable launch vehicles.

Controlled from Hong Kong

AsiaSat 1 will be controlled from a satellite control centre, at AsiaSat's head office in Hong Kong. The satellite control center will be conneted by a ten kilometer terrestrial link to the AsiaSat earth station at Stanley on the south side of Hong Kong Island. Hughes Aircraft has designed the control centre, the earth station and the associated computer systems.

Operators for the control centre have been recruited locally in Hong Kong. They are being trained by Hughes Aircraft in Los Angeles.

THE FOOTPRINT

Once AsiaSat 1 is stationed in geosynchronous orbit 35,800 Km above the equator, it will have a view of one-third of the earth's surface. This one-third of the earth's surface is home to more than half of the people on the planet.

The satellite antenna will be configured for two Asian beams. The Northern Beam will cover China, Korea, Nepal and Hong Kong, while the Southern Beam will cover Thailand, Pakistan and their neighbouring countries.

The Northern Beam

Twelve transponders on the satellite's northern beam will provide telecommunications services to over 1.2 billion people. In China, the satellite will be used as back-up to the domestic satellite system, as supplementary service for new private networks and as a transmitter of national and provincial television programs. In Korea, it will be used for private networks and for the emerging Cable Television Industry. In Hong Kong, AsiaSat 1 will be used for specialized television applications such as broadcasting to regional hotels.

The market for telecommunications services in China is growing as fast as in any other country. Recent statistics indicate that the number of long distance lines that are being used between Hong Kong and China is growing by over twenty (20) percent per year. The television industry in China is also growing rapidly. The dramatic growth in China and the continuing strength of the economies of Korea and Hong Kong are creating significant new demands for satellite communications services.

The Southern Beam

The other twelve transponders on AsiaSat 1 will be focused on Thailand and Pakistan. This will provide the most powerful C-band signal yet available over the countries that lie south of China, from the South China Sea to the Persian Gulf.

The eastern portion of this beam will be focused on central Thailand where its 37 dBW signal will be twice as powerful as any other existing satellite signal. The countries of Vietnam, Cambodia, Laos and Burma will be fully covered by this beam while Peninsula Malaysia and Singapore will also have good coverage.

The western portion of the beam will be focused on Pakistan where it will provide a singal strength between 36 and 37 dBW. Bangladesh, Nepal, Northern India, Afghanistan and Iran will all be well covered by this beam.

APPLICATIONS

AsiaSat is dedicated to providing domestic telecommunications services to Asian countries. These services include trunk route telecommunication service which will support the existing internal telephone systems, thin route systems for private users and television distribution service for the many developing Asian networks.

Trunk Routes

AsiaSat will be available to the domestic telephone systems such as the Ministry of Posts and Telecommunications (MPT) in China and the Telephone Organization of Thailand (TOT) to provide high speed circuits for telephone and data between major cities. This form of telecommunication might also be used for large private networks.

An earth station designed for trunk route applications would have a maximum required size of seven (7) meters in diameter. Between two such stations, one 2 Mbps carrier could be used to carry 60 voice channels with Low Rate Encoding

Technology (LRE). If Digital Circuit Multiplication Equipment (DCME) is used, 150 voice channels could be carried. Each transponder will be capable of carrying 16 of these 2 Mbps carriers which is equivalent to 960 voice channels using Low Rate Encoding (LRE) and 2400 using Digital Circuit Multiplication Equipment (DCME). If one 45 Mbps circuit is used, AsiaSat would be capable of carrying over 3,000 voice channels using DCME.

Thin Routes

The second major application for AsiaSat will be for thin route telecommunications. These include private networks for banks, offshore oil rigs, hotels, airlines and any other private sector or government institution which needs to transmit voice, data or image over large distances. Thin route technology can also be used to provide rural telecommunications services.

Rural telecommunications will be one of the most significantly beneficial applications of AsiaSat. By combining the higher power of this satellite with the latest advancement in VSAT technology, it will be possible to create very efficient rural telecommunications networks anywhere in Asia. With a 2.4 or 3 meters diameter dish, a small remote village will be able to connect 3 or 4 telephone or fax channels to the national telephone network. These dishes can be set up very quickly in any location and will provide an important new link for thousands of small communities.

Television Distribution

The third and potentially largest use for AsiaSat will be for the distribution of television. This will be primarily for the use of broadcasters that wish to transmit national programs to major cities or to transmit provincial programs to smaller communities.

The hub of an AsiaSat television distribution network would have an earth station diameter of between nine and eleven meters.

Typically this station would be located at the central studio in a national or provincial capital. Major programming would be delivered to local studios for incorporation with local programs and subsequent retransmission. There is also a growing need for local stations to have the capacity of delivering local programs such as news and sports back to the national hub.

The TV-Receive Only stations, TVRO's, that would be used with AsiaSat 1 as part of a TV network will vary in size depending on the quality of signal required. A 4.5 meter TVRO would be used by a local station using high-powered transmission facilities. If only lower-powered retransmission is required then the size of the TVRO could be reduced to 3 meters.

Cable Television is a rapidly developing industry in many Asian countries and the distribution of programming to the many new local cable networks is expected to become an important user of AsiaSat services. Independent cable operators may wish to obtain access to international broadcasts such as CNN or the Disney Channel and AsiaSat can be expected to be the most efficient distribution system for these broadcasts.

AsiaSat will be useful to Asian countries for delivering sports and news broadcasts from remote locations. Major international sporting events such as the Asian Games can be broadcast directly from the stadium to national networks where editing and commentary can be added before rebroadcasting. Special news events can also be covered more easily by using 3.5 meter Satellite News Gathering (SNG) Systems.

The television industry is growing rapidly throughout Asia but the growth in China has been the most dramatic. This phenomenon is highlighted by the fact that there were more television sets sold in China in 1988 than existed in China in 1980. While China had less than 10 million television sets at the beginning of this decade, the total now exceeds 100 million sets. The Chinese government has indicated that it expects this trend to continue and forecasts that by the year 2000 there will be an average of one TV set per household in China.

The development of the TV market in China has led to an expansion in the quantity and quality of broadcasting throughout the country. The Central China Television Network (CCTV) and the China Educational Television Network (CETV) are both supplying more and more programs while provincial networks are also developing. While the broadcasting industry continues its rapid growth, the demands for satellite capacity for television is also growing.

The experience of China is also being seen in many Asian countries such as Thailand and Pakistan. In Thailand, a fifth network which is designed primarily for educational programming is in the process of establishing a new system of regional studios. Thailand is also in the process of changing its regulation on cable television and this is expected to significantly increase the availability of programs in the major cities. In Pakistan, the development of a second network is expected within a few years.

The development of the television industries of Asian countries is seen as the major market force which will effect the use of AsiaSat. The new networks will require the use of a satellite as a programming market place and as a distribution network.

SUMMARY

The AsiaSat project will provide Asian countries with shared access to economical world-class domestic satellite service. Factors such as vast distances and harsh terrain will no longer constrain the availability of communications. A new world of education and entertainment will open up for millions of people.

For most Asian governments, AsiaSat represents an opportunity to provide their people with the benefits of satellite communications at internationally competitive rates. For the United States, AsiaSat represents an opportunity to provide a product which will assist in the development of Asia. For China, AsiaSat represents the benefits of the open-door policy and for Hong Kong, AsiaSat represents confidence in its future as a major transportation and communications link between East and West.

When AsiaSat is launched in April, one dream will come true and we can be certain that on that night thousands of new dreams will be born.

A STUDY ON THE HITCHHIKER PAYLOAD FOR PAN-PACIFIC INFORMATION NETWORK

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ABSTRACT

The Pan-Pacific Information Network, which is a non-profit satellite communication system, is desirable to be constructed by using low cost and simple earth stations for mutual communication and information exchange in the field of education, research and health in the Pacific region. This paper proposes a satellite transponder dedicated to the Pan-Pacific Information Network as a hitchhiker payload to the appropriate communication satellite. In order to clarify the technical feasibility of the transponder, this paper describes the system design, which includes the trade-off study of frequency selection, hitchhiker payload requirement and the earth station configuration. The preliminary result of the payload design shows that the S band payload will have weight of 2.7-3.4 kg and the consumption power of 38-48 W. The cost of an earth station will be around 1,000,000 Yen or around $6,900, if the volunteer group support to prepare such earth stations.

1. INTRODUCTION

The Pan-Pacific Information Network, which is a non-profit satellite communication system, is desirable to be constructed by using low cost and simple earth stations for mutual communication and information exchange in the field of education, research and health in the Pacific region. In the Pacific region, several non-commercial networks using NASA's Applications Technology Satellite ATS-1 for education and health, such as a PEACESAT (Pan-Pacific Education and Communication Experiments by Satellites), were active until the satellite ceased its operation in 1985. The alternative satellite is required for the successor of ATS-1, but the problem has not been solved yet completely(1).

Such a Pan-Pacific Information Network would primarily have no conflict of interests and be useful for the academic and cultural exchange among the people in the region. The concept of this network is almost the same concept as PEACESAT. In order to obtain the satellite facility, there might be problems especially in the budget. Considering such problems, this paper proposes the following two things to construct the Pan-Pacific Information Network using low-cost earth stations:

(i) A satellite transponder dedicated to the network which hitchhikes on the appropriate communication satellite.

(ii) Utilization of the earth stations which are prepared by the volunteer group to make the cost low. The authorized organization such as Communications Research Laboratory will offer technical support for preparation.

We call such a satellite transponder as a hitchhiker payload in this paper. First, we describe the background of this paper. Next, we clarify the technical feasibility of the hitchhiker payload by discussing the system design and requirement of the hitchhiker payload. Finally, the result of preliminary payload design is described.

2. BACKGROUND OF THE STUDY ON THE HITCHHIKER PAYLOAD(2)

2.1 Pan-Pacific Information Network

The Pan-Pacific Information Network Project was proposed and discussed at the Pacific ISY (International Space Year) Conference held in Hawaii on August 19-21, 1987. And the proposed agenda of the project was approved at the conference.

The Pan-Pacific Information Network would be configured in order to conduct things; (1)long distance classroom, (2)educational information exchange, (3)sharing of the educational software, (4)reference of various data base, (5)exchange of education text, (6)reference of various data bases, etc. via (a)voice communication, (b)document communication and (c)high speed multimedia, based on the experiments on the ATS-1 networks such as PEACESAT.

To realize such a network, the following steps have been proposed:

Phase 1: Post ATS-1 Network.

Phase 2: Computer Network with Small Satellite Channel.

Phase 3: Multimedia Computer Network System.

2.2 Recent Activities in Japan

The recent activities in Japan concerning the Pan-Pacific Information Network are described briefly. There are three groups in Japan for establishment of the Pan-Pacific Information Network. These groups work together and exchange information each other. The members of one group are also members of another group. The first is the group of Tohoku University as a contact point in Japan for PEACESAT user's group. The second group is the Pacific Island Telecommunication (PIT) Committee of the Japan Pacific Society. The PIT Committee has a meeting every two months and the members exchange the information concerning the communication system in the Pacific region. The PEACESAT-PIT Joint Meeting took place on June 21, 1989. The third group is the Pan-Pacific Information Network Study Group which has been originated by the Japanese group for the Space Communication Technical Panel of the Pacific ISY Conference.

The activities in the Ministry of Posts and Telecommunications are as follows: The Study Group on Telecommunication Development in the Pacific-Nesia was established recently under the auspices of the Communications Policy Bureau, Ministry of Posts and Telecommunications. The scope of the group is to recommend on how Japan can contribute to the improvement and expansion of the international and domestic telecommunications in the Pacific area. The study group will meet once every month and a report is scheduled to be presented by the end of March 1990. The ministry is also studying the possibility to apply the ODA (Official Development Aid) to establish the communication satellite "Asia-Pacific Satellite".

This paper is based on these two-year discussion at the PIT Committee of the Pacific Society of Japan and the Pan-Pacific Information Network Study Group and with the people concerned.

3. SYSTEM DESIGN

3.1 System Configuration

We consider the system which consists of a satellite and the simple earth stations widely distributed in the Pacific region as shown in Fig. 1. We assume that the system is configured by using no hub station which has a large aperture antenna. The example of using such a system can be considered as follows: The information such as educational materials is transmitted from the center earth station to all of the earth stations distributed in the region. The information such as questions can be returned from the earth stations to the center earth station. The global beam coverage, whose beam width is approximately 17 degrees, might be appropriate to this system, since the earth stations would be distributed to the Pacific region. The transmission rate of 64 kb/s would be preferable for the future applications linked to the ISDN (Integrated Services Digital Network). The following description is given under assumption of the system configuration shown in Fig. 1.

3.2 Frequency Band Selection

It is necessary to select the frequency band, considering:

(i) the limitation of on-board equipment,

(ii) cost of earth station, and

(iii) interference to/from other systems.

Especially considering (ii), it is the most significant point to make the earth station inexpensive that the earth station could be configured by applying the amateur radio equipments. In this case, the S band or lower frequency would be practical.

In order to conduct the trade-off study on the frequency band selection, we assume in this paper that frequency bands allocated to the services, such as space research, space operation and fixed satellite services, by the Radio Regulations are to be appropriate for the Pan-Pacific Information Network. Such frequency bands are picked up in Table 1. Since the frequency band of 2025-2300 MHz is used for satellite telemetry and command and one of 1530-1535 MHz is allocated to the mobile satellite service, these frequency bands are not considered to be suitable to the Pan-Pacific Information Network. Therefore, the following is the trade-off study concerning VHF, UHF, L and S band, whose definitions are shown in Table 1.

(1) VHF Band

The link budget in Table 2 shows that the data rate of 16 kb/s can be accommodated with the bit error rate (BER) of 1×10^{-5}. The relatively large output power of the earth station can be obtained easily in the VHF band. The study would be useful since the advanced device was developed recently. Furthermore, the frequency is approximately same as one of ATS-1 and the earth station could be used by slightly retuning.

However, the VHF band is unsuitable for future high speed data transmission due to limitation of bandwidth of +/-25 kHz per channel. Moreover, the experiment using ATS-1, which was conducted by Tohoku University, showed that fading and impulse noise were heavy(3). Therefore, the VHF band might be not appropriate to the Pan-Pacific Information Network.

(2) UHF Band

Concerning the UHF band, the electric performance of devices might be approximately same as in the VHF-band. The higher gain of antenna can be obtained easily than the VHF band. However, since the propagation loss increases approximately 10 dB in comparison of the VHF band, the link budget, shown in Table 3, gives that the data rate of 16 kb/s with $BER = 1 \times 10^{-5}$ would be max-

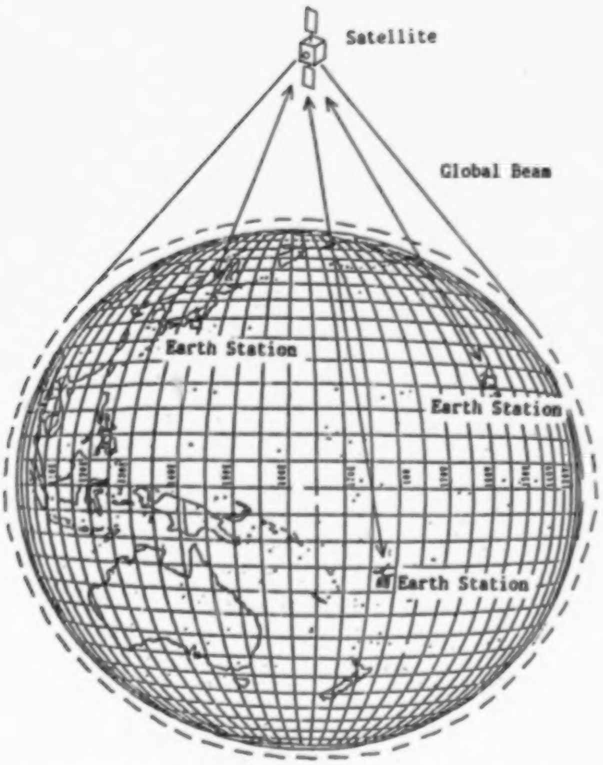
Satellite
Global Beam
Earth Station
Earth Station
Earth Station

Fig. 1 System Concept of Pan-Pacific Information Network.

Table 1 CANDIDATE FREQUENCY BAND

Service	Space→Earth	Earth→Space	Remarks
SO,SR	137-138 MHz		ATS-1
sr	138-143.6		149.22/135.6 MHz
SR	143.6-143.65		VHF Band
sr	143.65-144		
so		148-149.9 MHz	±25kHz/ch
so	267-272		
SO	272-273		
so	400.15-401		
SO	401-402		UHF Band
so,sr		449.75-450.25	
SO		1427-1429	L Band
SO	1525-1530		
SO	1530-1535		
sr,SO		2025-2110	
sr		2110-2120	
sr,so	2200-2290		
SR	2290-2300		
FSS	2500-2535		S Band
FSS		2655-2690	

SO:Space Operation(Primary), SR:Space Research(Primary),
FSS:Fixed Satellite Service(Primary)
so:Space Operation(Secondary), sr:Space Research(Secondary)

Table 2 VHF BAND LINK BUDGET

- Up-Link -				- Down-Link -			
Up Freq.	(GHz)	0.15		Down Freq.	(GHz)	0.14	
Transmit Pwr	(dBW)	20.00	(100.00 W)	XPDR Gain	(dB)	142.00	
Feeder Loss	(dB)	1.00		Transmit Pwr	(dBW)	7.44	(5.55 W)
Ant. Type		15ele Yagi		Feeder Loss	(dB)	1.00	
Ant. Gain	(dB)	15.00		Ant. Gain	(dB)	0.00	
Point. Loss	(dB)	0.00					
EIRP	(dBW)	34.00		EIRP	(dBW)	6.44	
Path Loss	(dB)	167.56	(38,000 km)	Path Loss	(dB)	166.96	(38,000 km)
Abs. Loss	(dB)	0.00		Abs. Loss	(dB)	0.00	
Ant. Gain	(dB)	0.00		Ant. Type		15ele Yagi	
Feeder Loss	(dB)	1.00		Ant. Gain	(dB)	15.00	
Receive Pwr	(dBW)	-134.56		Point Loss	(dB)	0.00	
T sys	(K)	586.57		Feeder Loss	(dB)	1.00	
T ant	(K)	300.00		Receive Pwr	(dBW)	-146.52	
T feeder	(K)	59.64		T sys	(K)	373.03	
T receiver	(K)	288.63		T ant	(K)	300.00	
(NF)	(dB)	3.00		T feeder	(K)	59.64	
No	(dBW/Hz)	-200.92		T receiver	(K)	75.09	
				(NF)	(dB)	1.00	
				(G/T)	(dB/K)	-10.72	
				No	(dBW/Hz)	-202.88	
C/No)up	(dB-Hz)	66.36		C/No)dwn	(dB-Hz)	56.36	
C/No)total	(dB-Hz)	55.95					
C/No)req	(dB-Hz)	46.54					
Bit rate	(kb/s)	16.00					
Eb/No)req	(dBHz)	9.60					
Coding Gain	(dB)	5.10	(R=1/2, K=7, Viterbi decoding)				
BER		1E-05	(with FEC)				
Margin	(dB)	9.41					

Table 3 UHF BAND LINK BUDGET

- Up-Link -				- Down-Link -			
Up Freq.	(GHz)	0.45		Down Freq.	(GHz)	0.40	
Transmit Pwr	(dBW)	17.00	(50.00 W)	XPDR Gain	(dB)	145.00	
Feeder Loss	(dB)	1.00		Transmit Pwr	(dBW)	5.90	(4.90 W)
Ant. Type		15ele Yagi X4		Feeder Loss	(dB)	1.00	
Ant. Gain	(dB)	20.00		Ant. Gain	(dB)	3.00	
Point. Loss	(dB)	0.00					
EIRP	(dBW)	36.00		EIRP	(dBW)	7.90	
Path Loss	(dB)	177.10	(38,000 km)	Path Loss	(dB)	176.08	(38,000 km)
Abs. Loss	(dB)	0.00		Abs. Loss	(dB)	0.00	
Ant. Gain	(dB)	3.00		Ant. Type		15ele Yagi X4	
Feeder Loss	(dB)	1.00		Ant. Gain	(dB)	20.00	
Receive Pwr	(dBW)	-139.10		Point Loss	(dB)	0.00	
T sys	(K)	586.57		Feeder Loss	(dB)	1.00	
T ant	(K)	300.00		Receive Pwr	(dBW)	-149.18	
T feeder	(K)	59.64		T sys	(K)	373.03	
T receiver	(K)	288.63		T ant	(K)	300.00	
(NF)	(dB)	3.00		T feeder	(K)	59.64	
No	(dBW/Hz)	-200.92		T receiver	(K)	75.09	
				(NF)	(dB)	1.00	
				(G/T)	(dB/K)	-5.72	
				No	(dBW/Hz)	-202.88	
C/No)up	(dB-Hz)	61.82		C/No)dwn	(dB-Hz)	53.70	
C/No)total	(dB-Hz)	53.08					
C/No)req	(dB-Hz)	46.54					
Bit rate	(kb/s)	16.00					
Eb/No)req	(dBHz)	9.60					
Coding Gain	(dB)	5.10	(R=1/2, K=7, Viterbi decoding)				
BER		1E-05	(with FEC)				
Margin	(dB)	6.54					

imum same as the VHF band, although the smaller link margin than the VHF band may be acceptable. The bit rate of 16 kb/s might be not enough to accommodate future applications of the Pan-Pacific Information Network.

(3) L Band

The amateur radio equipment can be still applied to this band and the earth station can be easily configured. The link budget is given in Table 4. The earth station, which has 1.8 m diameter antenna, 5 W output power and 2.7 dB/K G/T, can be used for 64 kb/s transmission with $BER=1x10^{-6}$.

However, the L band in Table 1 is allocated not only to the space operation service but also to the terrestrial fixed and mobile services. This band is also used for the search for international emission of extra-terrestrial origin. Then, there might be no room of frequency to accommodate the Pan-Pacific Information Network satellite communication system. Moreover, the on-board antenna is needed to be 0.7 m diameter. Such a size may be too large to place the antenna on the earth oriented panel of communication satellite as a hitchhiker payload, even though a helical antenna or patch array antenna could be used. It can not be considered that the L band meets completely to the requirement of the hitchhiker payload.

(4) S Band

The S band is allocated to the fixed, broadcast and mobile satellite service. It is also allocated to the terrestrial mobile service. However, this band can be used for the regional fixed satellite service in Region 2 and 3 according to the footnote No. 761 of the Radio Regulations.

From the device point of view, the transmitter power and receiver noise figure of devices in the S band would be available approximately same as in the L band. Therefore, the link budget in the S band has not largely different from the L band case. The link budget in Table 5 shows that the earth station, which has 1.8 m diameter antenna, 5 W output power and 4.8 dB/K G/T, could transmit 64 kb/s data with $BER=1x10^{-6}$. Since the antenna of the S band will be approximately 60% in size of the L band antenna for global coverage, the smaller size and lighter weight of the on-board equipments will be available. Then, the S band can be regarded as the most suitable frequency for a hitchhiker payload. However, the interference to/from mobile satellite service in the S band should be studied. A few amount of frequency would be needed to be assigned exclusively to the Pan-Pacific Information Network.

3.3 Communication Capacity

The large communication capacity would be rather undesirable, considering the network described here is non-profit. In order to make the network operation flexible, two channels would be preferable. Therefore, two-channel bent-type transponder is suitable to the Pan-Pacific Information Network. However, if the weight of the on-board equipment increases seriously due to the requirement of two channels, only one channel transponder would be agreeable.

3.4 Weight, Consumption Power, Size and Interface

The payload considered here takes a small amount of resources, such as weight, volume, area on earth oriented panel, field of view to the earth, electric power, heat capacity, telemetry and command from the satellite to be hitchhiked. Considering the payload is a hitchhiker one, it would be desirable that the weight of on-board equipment, including antenna, transponder, thermal control materials, is 3 kg or less, which means 0.5% or less in weight of the mission payload of 2-ton class satellite. The consumption power is appropriate to be 50 W or less. The size of the equipment is required to be as small as possible. Approximately 0.2 m^2 of area on the earth oriented panel is required for the on-board antenna. The field of view of +/-8 degrees is necessary for the global beam coverage. The telemetry of only input and output signal level and the command of only on/off of the transponder are assumed. Both the electrical and mechanical interface should be minimum.

3.5 Candidate Satellites

It is appropriate to the Pan-Pacific Information Network that the satellite to be hitchhiked is located between approximately 130 deg. East and 170 deg. West. The examples of communication satellites which are going or planned to be launched in the Pacific region are enumerated as follows:

(i) EDRTS/BCTS(Experimental Data Relay and Tracking Satellite/Broadcasting Communications Technology Satellite) which is planned to be launched in 1995. Since this satellite will be located at 90-110 deg. East, the location will not suitable for this network described here. But the development of this mission equipment can be accomplished.

(ii) DRTS (Data Relay and Tracking Satellite). DRTS is considered by NASDA (National Space Development Agency of Japan) and is planned to be launched in 1996 or later. One of locations of DRTS's would be 170 deg. West.

(iii) AUSSAT-B (launch year: 1993, location: 156-160 deg. East).

(iv) INTELSAT-VII.

(v) 3-rd Generation INMARSAT.

(vi) Japan's CS-4 (launch year: 1995 and 1996).

(vii) Asia-Pacific Satellite (See Section 2.2).

It is not sure at the present stage whether there is a candidate satellite or not. We hope that at least one of these satellites or others will fit to the candidate satellite which bears the hitchhiker payload.

3.6 Earth Station

In Table 5, the output power of the earth station is required to be 5 W. This output power can be obtained by using two terminal device, such as a varactor diode. In order to configure the high power amplifier (HPA) by using three terminal device such as transistor, Table 6 shows another link budget which can use 1 W HPA and 3 m diameter dish with mesh reflector.

Concerning the earth station technology, the following points should be considered:

Table 4 L BAND LINK BUDGET

- Up-Link -				- Down-Link -			
Up Freq.	(GHz)	1.40		Down Freq.	(GHz)	1.50	
Transmit Pwr	(dBW)	7.00	(5.01 W)	XPDR Gain	(dB)	145.00	
Feeder Loss	(dB)	1.50		Transmit Pwr	(dBW)	2.56	(1.80 W)
Ant. Dia	(m)	1.80	(η=50%)	Feeder Loss	(dB)	2.00	
Ant. Gain	(dB)	25.42		Ant. Gain	(dB)	16.00	
Point. Loss	(dB)	0.30					
EIRP	(dBW)	30.62		EIRP	(dBW)	16.56	
Path Loss	(dB)	186.96	(38,000 km)	Path Loss	(dB)	187.56	(38,000 km)
Abs. Loss	(dB)	0.10		Abs. Loss	(dB)	0.10	
Ant. Gain	(dB)	16.00		Ant. Dia	(m)	1.80	(η=50%)
Feeder Loss	(dB)	2.00		Ant. Gain	(dB)	26.02	
Receive Pwr	(dBW)	-142.44		Point Loss	(dB)	0.30	
T sys	(K)	415.95		Feeder Loss	(dB)	1.50	
T ant	(K)	300.00		Receive Pwr	(dBW)	-146.88	
T feeder	(K)	107.02		T sys	(K)	216.42	
T receiver	(K)	119.64		T ant	(K)	80.00	
(NF)	(dB)	1.50		T feeder	(K)	84.70	
No	(dBW/Hz)	-202.41		T receiver	(K)	75.09	
				(NF)	(dB)	1.00	
				(G/T)	(dB/K)	2.66	
				No	(dBW/Hz)	-205.25	
C/No)up	(dB-Hz)	59.97		C/No)dwn	(dB-Hz)	58.36	
C/No)total	(dB-Hz)	56.08					
C/No)req	(dB-Hz)	52.56		pfd	(dBW/m^2/4kHz)	-161.07	(BPSK)
Bit rate	(kb/s)	64.00		HPBW of STN	(deg.)	8.33	
Eb/No)req	(dBHz)	9.60					
Coding Gain	(dB)	5.10	(R=1/2, K=7, Viterbi decoding)				
BER		1E-05	(with FEC)				
Margin	(dB)	3.52					

Table 5 S BAND LINK BUDGET

- Up-Link -				- Down-Link -			
Up Freq.	(GHz)	2.60		Down Freq.	(GHz)	2.50	
Transmit Pwr	(dBW)	7.00	(5.01 W)	XPDR Gain	(dB)	145.00	
Feeder Loss	(dB)	1.50		Transmit Pwr	(dBW)	2.56	(1.80 W)
Ant. Dia	(m)	1.80	(η=50%)	Feeder Loss	(dB)	2.00	
Ant. Gain	(dB)	30.80		Ant. Gain	(dB)	16.00	
Point. Loss	(dB)	0.30					
EIRP	(dBW)	36.00		EIRP	(dBW)	16.56	
Path Loss	(dB)	192.34	(38,000 km)	Path Loss	(dB)	192.00	(38,000 km)
Abs. Loss	(dB)	0.10		Abs. Loss	(dB)	0.10	
Ant. Gain	(dB)	16.00		Ant. Dia	(m)	1.80	(η=50%)
Feeder Loss	(dB)	2.00		Ant. Gain	(dB)	30.45	
Receive Pwr	(dBW)	-142.44		Point Loss	(dB)	0.30	
T sys	(K)	415.95		Feeder Loss	(dB)	1.50	
T ant	(K)	300.00		Receive Pwr	(dBW)	-146.88	
T feeder	(K)	107.02		T sys	(K)	372.17	
T receiver	(K)	119.64		T ant	(K)	300.00	
(NF)	(dB)	1.50		T feeder	(K)	84.70	
No	(dBW/Hz)	-202.41		T receiver	(K)	75.09	
				(NF)	(dB)	1.00	
				(G/T)	(dB/K)	4.75	
				No	(dBW/Hz)	-202.89	
C/No)up	(dB-Hz)	59.97		C/No)dwn	(dB-Hz)	56.01	
C/No)total	(dB-Hz)	54.54					
C/No)req	(dB-Hz)	52.56		pfd	(dBW/m^2/4kHz)	-161.07	(BPSK)
Bit rate	(kb/s)	64.00		HPBW of STN	(deg.)	4.49	
Eb/No)req	(dBHz)	9.60					
Coding Gain	(dB)	5.10	(R=1/2, K=7, Viterbi decoding)				
BER		1E-05	(with FEC)				
Margin	(dB)	1.98					

Table 6 S BAND LINK BUDGET (CASE OF USING 1 W HPA)

- Up-Link -				- Down-Link -			
Up Freq.	(GHz)	2.60		Down Freq.	(GHz)	2.50	
Transmit Pwr	(dBW)	0.00	(1.00 W)	XPDR Gain	(dB)	145.00	
Feeder Loss	(dB)	1.50		Transmit Pwr	(dBW)	0.00	(1.00 W)
Ant. Dia	(m)	3.00	(η=50%)	Feeder Loss	(dB)	2.00	
Ant. Gain	(dB)	35.23		Ant. Gain	(dB)	16.00	
Point. Loss	(dB)	0.30					
EIRP	(dBW)	33.43		EIRP	(dBW)	14.00	
Path Loss	(dB)	192.34	(38,000 km)	Path Loss	(dB)	192.00	(38,000 km)
Abs. Loss	(dB)	0.10		Abs. Loss	(dB)	0.10	
Ant. Gain	(dB)	16.00		Ant. Dia	(m)	3.00	(η=50%)
Feeder Loss	(dB)	2.00		Ant. Gain	(dB)	34.89	
Receive Pwr	(dBW)	-145.00		Point Loss	(dB)	0.30	
T sys	(K)	415.95		Feeder Loss	(dB)	1.50	
T ant	(K)	300.00		Receive Pwr	(dBW)	-145.01	
T feeder	(K)	107.02		T sys	(K)	372.17	
T receiver	(K)	119.64		T ant	(K)	300.00	
(NF)	(dB)	1.50		T feeder	(K)	84.70	
No	(dBW/Hz)	-202.41		T receiver	(K)	75.09	
				(NF)	(dB)	1.00	
				(G/T)	(dB/K)	9.18	
				No	(dBW/Hz)	-202.89	
C/No)up	(dB-Hz)	57.40		C/No)dwn	(dB-Hz)	57.88	
C/No)total	(dB-Hz)	54.63					
C/No)req	(dB-Hz)	52.56		pfd	(dBW/m^2/4kHz)	-163.63	(BPSK)
Bit rate	(kb/s)	64.00		HPBW of STN	(deg.)	2.69	
Eb/No)req	(dBHz)	9.60					
Coding Gain	(dB)	5.10	(R=1/2, K=7, Viterbi decoding)				
BER		1E-05	(with FEC)				
Margin	(dB)	2.07					

(1) The frequency for the Pan-Pacific Information Network is slightly different from one for the amateur radio. The little convergence of the equipment will be required.

(2) The S band equipment is still development stage. However, the following method can be applied: (I)5 W HPA case; the L band transceiver and a HPA which is a frequency doubler using a varactor diode. (II)1 W HPA case; the transceiver on the market can be applied to the IF (Intermediate Frequency) stage and a frequency-up converter and a HPA can be manufactured. The receiver can be easily configured in both cases.

(3) If the full duplex operation is required, a diplexer is needed to be used. However, the diplexer is usually expensive and gives more attenuation. Therefore, the half duplex (push-to-talk) operation is recommended to make the earth station simple.

(4)1.8 m or 3 m diameter dish antenna is on the market. Only the primary feed is needed to be developed.

(5) The MODEM (modulator/demodulator) on the market is up to 1.2 kb/s. The MODEM of 64 kb/s is needed to be developed. The devices are on the market.

(6) The CODEC (coder/decoder) which can accommodate convolutional encoder and Viterbi decoder is needed to be developed. The device has been developed.

The approximate cost of the earth station is estimated in Table 7. The cost will be around 1,000,000 Yen or around $6,900, excluding the installation and transport cost. The volunteer group should be support to prepare such earth stations. In this case, the authorized organization, such as Communications Research Laboratory, should offer the technical support for preparation.

Table 7 COST ESTIMATION OF EARTH STATION

ITEM	ESTIMATED COST (Unit:10,000 Yen)	REMARKS
Antenna	25	NSS's dish
TX & RX	25	*Primary feed
MODEM	20	
CODEC	20	
Others	10	
Total	100 (without delivery cost)	

Table 8 REQUIREMENT OF HITCHHIKER PAYLOAD

Antenna Gain	16 dBi or more
Sys. Noise Figure	3.8 dB or better
Power Output	1.8 W/ch or 1.0 W/ch*
Band Width	160 kHz/ch
No. of Channels	2**
Weight	3 kg or less
Consumption Power	50 W or less
Size	As small as possible
Remarks	*see Table5 and 6. **2 channels are desirable.

4. REQUIREMENT OF THE HITCHHIKER PAYLOAD AND FURTHER STUDY ITEMS

The major specification of the hitchhiker payload is reviewed in Table 8. The payload will

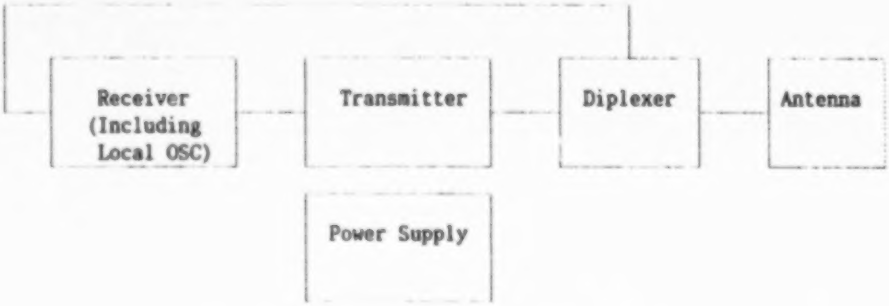

Fig. 2 Configuration of Hitchhiker Payload.

be configured as Fig. 2. The polarization of this system is assumed to be circular in the link budget.

The further study items are as follows:

(i) More detail study on the feasibility of this system.
(ii) Possibility of obtaining frequency.
(iii) The method of configuring the network.
(iv) The method of obtaining budget.

The cost to manufacture the hitchhiker payload is also the study item.

5. RESULT OF PRELIMINARY DESIGN

The preliminary design of this payload has been shown as follows:

Weight: 2.7-3.4 kg
Consumption power: 38-48 W

These values were estimated on the payload including a transponder of two channels and an onboard antenna. In the case of one-channel transponder, both weight and consumption power can be reduced. These estimated values are distributed to some range. However, they still meet the specification given in Table 8 approximately. The cost was estimated to be 250-300 million Yen or $1.7-2.1 million.

6. CONCLUSIONS

This paper has described the technical feasibility study of the hitchhiker payload dedicated to the Pan-Pacific Information Network. As a result, it has been clarified that such a payload can be designed technically. The hitchhiker payload will have approximately 3 kg of weight and 50 W of power consumption. Its cost will be around 30 million Yen or $2 million. The earth station can be configured by using amateur radio equipments and its cost will be around 1,000,000 Yen or $6,900, if volunteer group could be organized to prepare the earth station under the technical support of authorized organization. The further study items will be how to obtain the budget, how to find the satellite which can bear this hitchhiker payload, how to obtain the frequency, and how to construct the network.

Finally, the authors thank the people concerned, especially Prof. S. Noguchi of Tohoku University, Mr. Y. Makino, Chairman of PIT Committee, Prof. D. M. Topping, University of Hawaii, Prof. T. Ishida, Hokkaido Tokai University and Dr. I. Nakajima, Tokai University for their encouragement and discussion to prepare this paper and the people of NEC Corporation and Mitsubishi Electric Corporation for their help of designing the payload.

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ACTS: CONNECTIVITY FOR THE FUTURE

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1. ABSTRACT

By demonstrating the feasibility of a set of new technologies that will make the transmission of voice, video and data more efficient and cost-effective, NASA's Advanced Communications Technology Satellite (ACTS) is designed to answer many of America's telecommunications needs into the next century. By using the revolutionary technologies that will be demonstrated on ACTS, the inherent flexibility of satellites can be combined with existing technologies, like the wide bandwidth of optical fiber, to provide an economic means to open high-capacity routes to, as well as interconnect, geographically isolated areas using small earth stations.

The development of ACTS technology will permit the use of remotely located Very Small Aperture Terminals (VSATs) for high-capacity communications transmission. The potential uses of ACTS-developed technologies in the Pacific region represent an example of how advanced satellites can combine with existing and planned communications infrastructures to accommodate the projected, increasing communications requirements, especially of rural and remote areas.

As a NASA-sponsored Research and Development (R&D) program, ACTS will present a glimpse at the potential technology advancements in satellite communications. The ACTS experiments program will show the applicability of these technologies in a commercial environment.

2. ECHO TO ACTS: NASA'S ROLE IN THE DEVELOPMENT OF SATELLITE COMMUNICATIONS

With the 1962 launch of the first communications satellite, ECHO, NASA inaugurated an historic era of telecommunications research and development. This passive signal reflector also marked the genesis of the U.S. satellite industry.

In the years that followed, NASA developed and launched the Syncom series of satellites. These satellites demonstrated the feasibility of geosynchronous satellites, and were the first to deliver video images acceptable for television transmission.

The Applications Technology Satellites (ATS) were launched between 1966 and 1974. This series introduced and verified new technologies, such as despun and unfurlable antennas and the design and use of multiple frequency satellites. The ATS series developed and demonstrated many new satellite services including direct broadcast networks and land, aeronautic, maritime, and search and rescue systems. These experimental satellites also facilitated the development of smaller, low-cost earth stations capable of sending broadcast-quality signals. ATS-1 and ATS-3 continue to be used and serve as the backbone network in the Pacific for such organizations as PEACESAT and the University of the South Pacific in Fiji.

Also in the mid-1970's, the joint U.S.-Canada Communications Technology Satellite (CTS), or "Hermes," demonstrated direct-to-home broadcast satellites and applications using Ku-band, thus opening the door to a new frequency.

Beginning in 1973, most of NASA's satellite communications R&D funding was eliminated on the assumption that industry would continue such work. By 1978, however, it had become evident that industry would not be able to fill the gap left by the steep decline in NASA's communications satellite R&D budget. At the request of industry, NASA subsequently began conducting market-demand studies for an advanced satellite communications system, laying the groundwork for what would eventually become the ACTS program. Hardware development and operational system studies were initiated in 1981; in 1983 the program was restructured, its scope reduced, and it was renamed the "Advanced Communications Technology Satellite" Program. NASA's FY 1984 budget reflected this new start for ACTS through a $5 million allocation.

In 1984, the prime contract for the design, development, and fabrication of the ACTS spacecraft and payload integration was awarded to RCA Astro-Electronics (now GE Astro-Space). Other contractors on the ACTS Program include COMSAT, for the development of the NASA Ground Station and the Master Control Station; Motorola, for the development of the Baseband Processor (BBP) and ground modems; Orbital Sciences Corporation, for the provision of the Transfer Orbit Stage (TOS); Electromagnetic Sciences, for the development of the beam-forming network and accompanying electronics; and the Harris Corporation for the design and development of the experimenter ground stations.

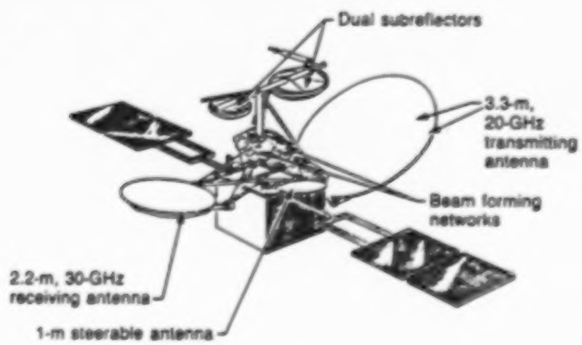
3. KEY ACTS TECHNOLOGIES

The key technologies to be validated as part of the ACTS Program include the Baseband Processor (BBP) — a high-speed digital spacecraft switch to efficiently use transponder capacity (in time and frequency) for routing individual circuit-switched messages; the Microwave Switch Matrix (MSM) — a dynamic reconfigurable switch to route high-volume point-to-point traffic; Ka-band components — the development of flight and ground terminal hardware at 30 and 20 GHz; and rain fade compensation procedures — techniques such as dynamic forward error correction and power control to automatically overcome uplink and/or downlink signal level changes.

Perhaps most important to those in the Pacific is the multiple beam antenna — a rapidly reconfigurable hopping and fixed spotbeam antenna. The hopping beams are most useful for serving areas where traffic is disseminated geographically and no single area has sufficient traffic to justify the use of a stationary spotbeam. Beam hopping aggregates the traffic from such regions and the onboard switch permits full interconnectivity between all spots.

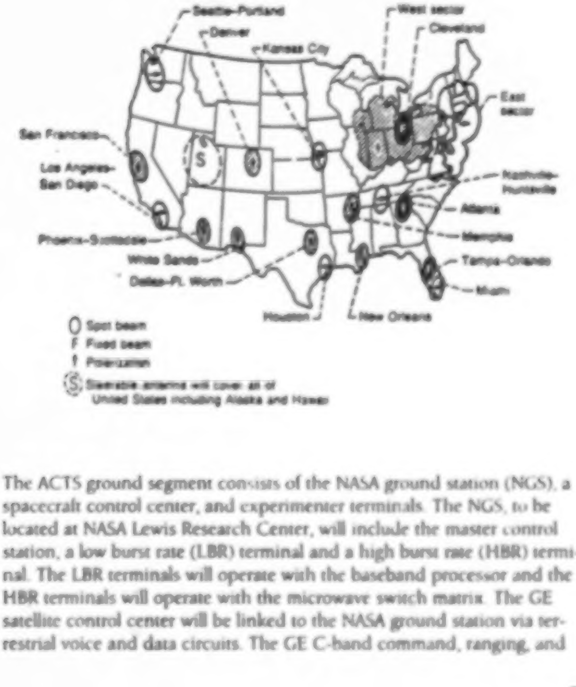
The ACTS System is comprised of both a flight segment and a ground segment. The flight segment consists of the multibeam communications package mentioned previously, and the spacecraft bus. In orbit, ACTS will "weigh" approximately 3,270 pounds and measure 46.5 feet from tip-to-tip along the solar arrays, and 30 feet from the edge of one antenna to the other. ACTS will be located in geosynchronous orbit at 100° west longitude. (See figure 1.)

FIGURE 1. ACTS SPACECRAFT CONFIGURATION


Dual subreflectors
3.3-m, 20-GHz transmitting antenna
Beam forming networks
2.2-m, 30-GHz receiving antenna
1-m steerable antenna

Separate Ka-band antennas, each with horizontal and vertical polarization subreflectors, are provided for transmitting and receiving signals. The offset Cassegrain antenna system will provide two hopping spotbeam families plus three fixed spotbeams. A steerable antenna, part of the West scan sector (see figure 2), will provide coverage to anywhere within the Western Hemisphere. Within the beam footprints, access will be by demand-assigned multiple access (DAMA) using time-division multiple access (TDMA) transmission. The multibeam communications package provides the means for receiving, processing, switching, amplifying and transmitting signals that carry high-speed digital communications traffic.

FIGURE 2. ACTS MULTIBEAM ANTENNA COVERAGE



The ACTS ground segment consists of the NASA ground station (NGS), a spacecraft control center, and experimenter terminals. The NGS, to be located at NASA Lewis Research Center, will include the master control station, a low burst rate (LBR) terminal and a high burst rate (HBR) terminal. The LBR terminals will operate with the baseband processor and the HBR terminals will operate with the microwave switch matrix. The GE satellite control center will be linked to the NASA ground station via terrestrial voice and data circuits. The GE C-band command, ranging, and telemetry station will provide transfer orbit support and serve as an operations backup to the satellite center. Additional ground terminals will be provided by government and private-sector experimenters.[1]

4. OBJECTIVES OF THE ACTS PROGRAM

Planned for launch in 1992, ACTS represents NASA's return to satellite communications development, and will demonstrate the feasibility of a variety of technologies that will be incorporated into future operational satellites. The ACTS demonstration and experiment program, and the verification of ACTS innovative technologies, hold the key to continued American technological preeminence, international competitiveness, domestic industry growth, and improved customer service in the satellite communications field.

Future ACTS-like systems could add a new dimension to communications services by combining the technologies of satellites and fiber optics. Fiber systems have been shown to offer excellent performance for point-to-point, high-volume "trunk" communications. Advanced satellites will be competitive with fiber systems in capacity, cost, performance, and reliability for point-to-point services, particularly in regions like the Pacific. More importantly advanced satellite links can team with fiber systems to expand the communications capabilities of users who are off of the main fiber backbone and, without satellite connections, would not have access to high-capacity transmission media.

5. APPLICATION OF ACTS TECHNOLOGIES TO THE PACIFIC REGION

5.1 Fiber Optic Lines in the Pacific

Currently, there is only one fiber optic cable connecting the mainland U.S. to Japan, by way of Hawaii. This cable, HAW-4/TPC-3, is fully subscribed and unable to offer capacity for carriers or large users to lease directly. The 8,271-mile cable has the capacity of 40,000 simultaneous phone calls, or their equivalent in data or video traffic.

Recently, plans have been revealed for the implementation of two additional high-capacity, digital, fiber optic cables linking the North American continent with Japan. This development makes the marriage between advanced satellite and fiber optic technologies even more plausible and relevant to users in that area.

The first to serve the region will be the private North Pacific Cable (NPC). This system, like the proposed TPC-4, will connect the mainland U.S. and Japan, following the "Great Circle" route, and will not run through Hawaii. A spur off of the main cable of the NPC however, will provide service to Alaska. Scheduled to be ready for service at the end of 1990, this cable system is already under construction.

The second cable proposed for this region is the Trans-Pacific Cable-4 (TPC-4), which will link the United States and Canada to Japan via Hawaii. Scheduled for operation in 1992, the so-called "Aloha" cable will have the capacity for 18,000 simultaneous voice conversations. With channel multiplication, the cable could carry about 54,000 simultaneous conversations.

5.2 Applicability of ACTS technologies

In light of the projected increase in communications capabilities resulting from the activation of these new cable systems, certain ACTS-verified technologies will be particularly useful in satisfying the specific communications requirements of users in the Pacific region.

Demand-assigned telephone circuits provided by ACTS will be particularly applicable in remote and rural areas, such as islands of the Pacific, where communications traffic is often sporadic. Unlike point-to-point, high-bandwidth fiber optic media, advanced satellites will be capable of aggregating traffic on a rapid demand-assignment basis and consequently will oblige users to pay only for the transmission time actually used. These capabilities will be made possible by ACTS-like scanning spotbeam and Ka-band TDMA transmission techniques.

Geographically isolated areas, of which there are a great number and variety in the Pacific region, can benefit greatly from the high-power spotbeam technology demonstrated on ACTS. Narrow spotbeams allow satellite energy to be focused on geographic-specific areas, making wide bandwidth available to isolated areas and locations that lie away from any other means of wide bandwidth transmission, e.g., fiber optic cable. The combination of the planned fiber infrastructure and hopping spotbeams of satellites could serve to link otherwise isolated areas to the communications capabilities available in more urban or densely populated areas.

ACTS onboard switching bypasses conventional switching hub networks on the ground, making it possible to directly connect remotely located and widely separated regions and do so on a demand-assigned basis. Demand assignment permits widely distributed users to share the ACTS transmission resource resulting in traffic concentration advantages for low traffic load users. This makes ACTS equivalent to five to ten times the number of directly connected terrestrial circuits and results in greater economy for users.(2)

As the amount and complexity of communications traffic increases, and more sophisticated communications technology is disseminated throughout the Pacific region, the demand for remote access to broadband transmission media will also increase. The wide bandwidth available at Ka-band will allow users with a need for high-capacity lines remote access to fiber networks.

Like other international commercial centers, the business trends in the Pacific dictate that there will be an inevitable evolution in corporate communications. Trends toward smaller, lower-cost earth stations, and their use with Integrated Services Digital Network (ISDN) technology will exploit the potential of an advanced technology, high-power satellite. ACTS-unique capabilities provide for full VSAT connectivity and high bandwidth in a single hop. This direct VSAT-to-VSAT connectivity will allow for voice grade communication, a significant advantage to users whose main traffic is voice signals. Additionally, this direct connectivity is a significant improvement over current VSAT networks which must operate via a centrally located terrestrial hub terminal. ACTS-like satellite VSAT networks will provide a high capacity, with a maximum throughput of T1 and up to T3 (45 Mbps). Even the current INTELSAT VISTA network cannot achieve this throughput rate.

FIGURE 3. ACTS MECHANICALLY STEERABLE ANTENNA COVERAGE

- STEERABLE ANTENNA PRODUCES A SINGLE 1° BEAM
- TO EXTEND THE COVERAGE
- MECHANICALLY STEERED TO ANYWHERE WITHIN DISK OF EARTH AS SEEN FROM 100° WEST LONGITUDE
- STEERING RATE IS APPROXIMATELY 1 DEGREE/MINUTE

The onboard steerable antenna, a part of the ACTS West Scan sector, was added to the ACTS system configuration at the request of U.S. Senators from Alaska and Hawaii, primarily to provide satellite coverage to those two states. The ACTS prime spacecraft contractor, GE Astro-Space, agreed to integrate the antenna into the system design, absorbing the cost of the antenna design and construction. This antenna operates on a slightly lower EIRP, but the coverage will be powerful enough for direct VSAT-to-VSAT connectivity. A map of the steerable antenna footprint is included in figure 3.

Finally, the climatic variations in the Pacific region present especially prominent application of the dynamic rain fade compensation techniques employed by ACTS. To examine the effect of atmospheric conditions on satellite transmission, ACTS was designed to meet the various climatic conditions. The diversity of circumstances in the Pacific present both the best and worst environment in which the advanced technologies will be used. The lessons learned during the ACTS Propogation Experiments program will enable future satellites to operate efficiently in the Pacific region at Ka-band. ACTS Propagation experiments will prove the feasibility of using Ka-band transmission despite the rain attenuation factors traditionally associated with that frequency.

6. THE SIGNIFICANCE OF ACTS FOR THE INFORMATION AGE

Technologies devised by the ACTS program are likely to narrow the dramatic chasm that separates the information service "haves" from the "have nots." Because of the wideband transmission needs associated with the information processing technologies to be perfected over the next decade, there is fear that these capabilities will be utilized only by those in the limited areas connected by fiber optic cable. Advanced communications satellites incorporating ACTS-validated technologies, however, will make more inclusive the availability of wideband transmission and subsequently increase access to the services and advantages made available in the "Information Age."

As discussed in *NTIA Telecom 2000: Charting the Course for a New Century*, this sort of universal availability of, not only basic phone service, but also that of new information technologies and applications, is a national priority. The report states, "limiting our concept of universal service to the narrow provision of basic voice telephone service no longer serves the public interest."(3) The development and application of technologies, like ACTS, that allow for the provision of wideband width connectivity among rural areas are integral to the accomplishment of this objective.

Furthermore, of importance to rural and remote areas will be the ability of these advanced technologies, specifically satellite technology, to provide broader band access at lower cost because of traffic aggregation and on-demand circuit assignment. Unlike the wide bandwidth provided by optical fiber, wideband satellite transmission is inclusive of any area regardless of its terrain or geographic location.

7. THE OPPORTUNITY OF ACTS

The ACTS program represents a unique opportunity for end-users, service providers and equipment manufacturers to assess the feasibility of new applications and new ways of providing existing applications. Regardless of whether the potential increase in communications demand is realized, employing ACTS-developed technologies in the Pacific region can certainly lead to the cost benefits derived from advanced satellite technologies. Additionally, ACTS technologies provide the opportunity for quantum leaps in communications capabilities.

This Spring, NASA will release a formal announcement of opportunity to conduct demonstrations and experiments using ACTS. It is during the demonstration period that the latest in NASA's communications R&D efforts will be examined and the groundwork laid for the next generation of communications satellites and services.

REFERENCES

1. For a more detailed description of the ACTS System, see the *ACTS System Handbook*, NASA Lewis Research Center, Cleveland, OH, NASA TM-101490; October, 1989.

2. Campanella, S.J. "Satellite Switches," *Satellite Integrated Communication Networks*; ed. E. Del Re, P. Bartholome, and P. P. Nuspel. North Holland, New York, NY, 1988.

3. *NRIA Telecom 2000: Charting the Course for a New Century.* National Telecommunications and Information Administration. U.S. Department of Commerce; Washington, DC; 1988.

EXPERIMENTAL MILLIMETER-WAVE SATELLITE COMMUNICATIONS SYSTEM

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ABSTRACT

Presented here are an experimental plan of the millimeter-wave communication between Japan and the Asia-Oceania region employing a steering function of gimbals platform mounted on the Japanese Engineering Test Satellite-VI (ETS-VI) and the outlines of the millimeter-wave transponder.

In PTCs 87 and 88, a possible satellite communication system based on a personal communication in the millimeter-wave band was described as a future communication system in the Asia-Oceania region, and an experiment employing ETS-VI was proposed.

In this paper, a further detailed descriptions are given for the experiment and the experimental system using the ETS-VI.

The millimeter-wave experimental equipments mounted on ETS-VI are a millimeter-wave (43/38GHz band) transponder developed by Communications Research Laboratory (CRL), a 30/20GHz band feeder link transponder and a millimeter-wave antenna developed by National Space Development Agency of Japan (NASDA). The fabrication of the electrical models of these equipments are already completed.

The principal functions and characteristics of them are also presented.

1. INTRODUCTION

The Asia-Oceania is a vast region dotted with many island countries. The geography of the region makes the wire-based communication system difficult to be constructed, and a steady satellite communication link has been desired for a long time.

However, the construction of an international satellite communication system would be very difficult from the economic point of view, because of the comparatively small communication demands and number of users.

Thus, a satellite communication system employing the millimeter-wave has been proposed in PTC 87 (1) and PTC 88 (2), using a simple communication system with small earth terminals.

The application of millimeter-wave bands to the satellite communication system has the following advantages:

i) Capability of providing a small light-weight earth terminal with a high gain antenna and compact transmitter/receiver (miniaturization of the required devices and the development of low-cost small earth terminals are expected in the near future),

ii) less interference susceptibility from other communication systems including terrestrial links,

iii) less possibility of interfering with other systems (this is very important for personal communication system in which users are numerous and unspecified), and

iv) flexibility for new services (the frequency bands, which have already been developed for the existing satellite communications system have many limitations in their band width and utilization according to the Radio Regulations).

Since the millimeter-wave band suffers large losses due to rainfall, the system has been recommended to be applied for personal usages which do not necessarily require high link availability. In this paper, as one of applications of millimeter-wave personal communications to the Asia-Oceania region, experiments on a data communication system providing non-realtime services is proposed.

This report describes the experimental plan using the ETS-VI to verify the effectiveness of the data communication service system on the millimeter-wave band. The experiment will be conducted using the millimeter-wave transponder, the feeder link transponder and millimeter-wave antenna with beam steering function. The millimeter-wave transponder whose electrical model development has been completed is also described.

2. MILLIMETER-WAVE COMMUNICATION EXPERIMENT BETWEEN JAPAN AND THE ASIA-OCEANIA REGION WITH ETS-VI

2.1 EXPERIMENTAL COMMUNICATION SYSTEM

As one of the communication experiments using ETS-VI, CRL is planning, the millimeter wave communication experiments utilizing the antenna beam steering function of the gimbal platform (developed by NASDA and accommodating K band satellite communication facilities)(3) on which the millimeter-wave transponder and its antenna are mounted for satellite communication use.

The objective of this experimental system is to test the application of the non-realtime data communication service rather than large capacity real-time communication.

This new service system will allow communication between the communication center and an opposite terminal during a communicatable time window settled for each region facilitating data, mail or message communication which does not require real time service.

This system can cover a vast area with high EIRP, without using a sophisticated multi-beam antenna, by the timely transfer of the antenna beam. The system will allow to construct an effective system for the scientific information interchange, information retrieval, news gathering and delivery etc..

As shown in the block diagram of Figure 2-1, ETS-VI is always connected to the experimental center in Japan (a hub station) by means of a feeder link channel (4), and also connected to the experimental earth terminals scattering around the Asia-Oceania region by the millimeter-wave link.

The direction of the millimeter-wave antenna beam can be controlled by the gimbal platform steering function to allow communications between the earth station in the antenna beam coverage area and the hub station.

Thus, as shown in Figure 2-2, the earth stations located within the antenna coverage area can be connected with the hub station by shifting millimeter wave antenna beam to changing the communication target area.

First, the antenna beam starts to point at a loacation according to the command which controls the antenna orientation. Then it shifts to the next location after a predetermined communication time, and after shifting over the whole locations,

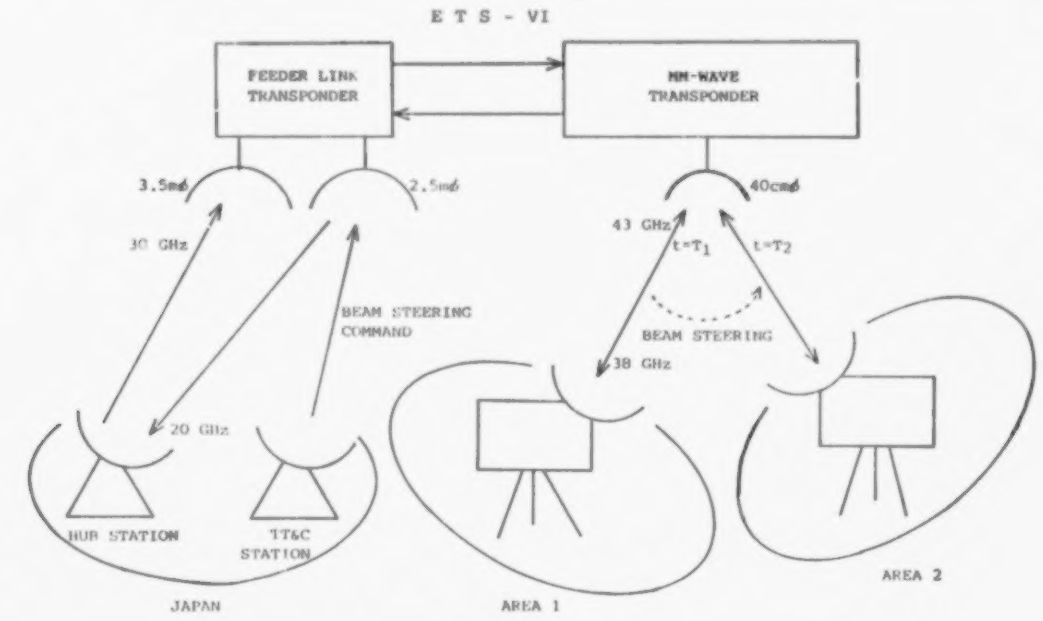


FIGURE 2-1. JAPAN-ASIA-OCEANIA COMMUNICATIONS EXPERIMENTAL SYSTEM VIA ETS-VI SATELLITE

returns to its original orientation.
This communication system provides essentially one to one communication between the hub station in Japan and each earth terminal in the Asia-Oceania region. Communications between earth terminals located in the Asia-Oceania region are also available by use of the data holding function of the hub station.

This system only in the interval of the antenna beam control such as 5 or 10 minutes.

The transmission and reception control at the earth terminals also only requires the kind of rough control interval which can be determined using a wrist watch. Therefore, no high precision communication control function is needed for the earth terminal, and the communication experiment facilities are very economical.

2.2 SMALL EARTH TERMINAL

For the experimental millimeter-wave band earth stations to be installed in the Asia-Oceania region, very small earth terminals for millimeter-wave personal communication will be employed.

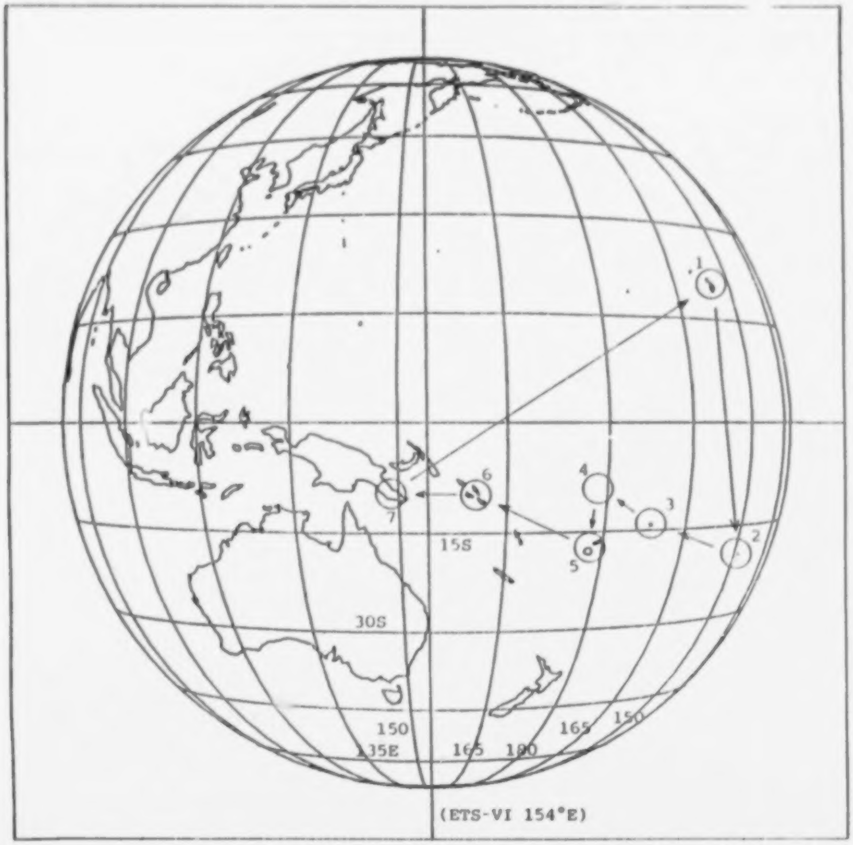
Such terminals will consist of low noise amplifiers, high power amplifiers, PLO type local signal oscillator with high frequency stability and low phase noise, etc., utilizing the newest technologies refined during the development of the on-board millimeter-wave transponder described later. Extensive miniaturization can be expected by developing an all-solid state transmitter circuit and MIMIC's.

Figure 2-3 shows the typical configuration of the small earth terminal. The antenna diameter is not increased indiscriminately since its size closely relates to the satellite tracking method.

The diameter should be 30 or 40cm to allow manual tracking, aiming to develop a simple earth terminal configuration. The antenna beam width (half power value) is almost 1.2 to 1.6 degrees enough to catch the satellite with a simple tracking mechanism.

The antenna diameter of the earth terminal will be finally decided taking the performance of the power amplifier and the low noise amplifier, into account.

An InP FET high power amplifier is under development aiming at an output power of 2 watts, as well as a 0.5 watt GaAs FET amplifier. The total weight is designed to be within 10 kg including the antenna, RF section, MODEM, CODEC



1 : HAWAII
2 : TAHITI
3 : WESTERN SAMOA
4 : TUVALU
5 : FIJI
6 : SOLOMON
7 : PAPUA NEW GUINEA

CIRCLES ARE PLOTTED WITH 0.75 DEGREE ϕ COVERAGE

FIGURE 2-2. AN EXAMPLE OF MM-WAVE ANTENNA DIRECTION SHIFTING PLAN FOR THE COMMUNICATION EXPERIMENT

and satellite tracking mechanism.

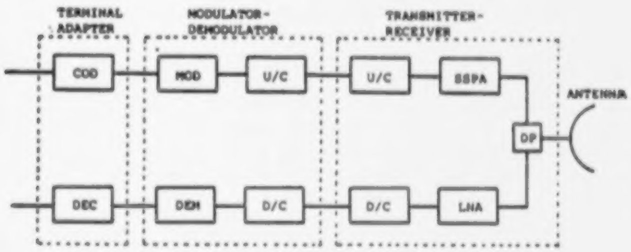


FIGURE 2-3. CONFIGURATION OF PERSONAL EARTH STATION

2.3 LINK BUDGET EXAMPLE

The communication link of this experimental system is composed of a millimeter-wave link of 43/38GHz and a feeder link of 30/20GHz. Since the quality of the feeder link is excellent compared with that of the millimeter-wave link, the total communication quality is determined by that of the millimeter-wave link.

Table 2-1 shows an example of the link calculation for 43 and 38GHz bands where the measured performance of the millimeter-wave transponder electrical model is used for the parameters.

From this calculation result, it is understood that a transmission speed of 64kbps sufficient for the experiment will be obtained with an antenna diameter of 30 cm and an output power of 1.0 watt for the small earth terminal.

An earth terminal with a 40-cm antenna and 2-watt output power should be developed considering the atmospheric absorption at low elevation angle operation in the tropics and the subtropics encountered in the experiment in such a low satellite elevation angle district as Hawaii.

2.4 ITEMS TO BE EXAMINED

The following items shall be further examined in detail in order to conduct the above mentioned experiment.

i) Communication system

- Packet configuration and communication protocol set-up.
- Modulation-demodulation system set-up.

ii) Beam control algorithm

- Beam control time sequence set-up. Optimization for maximum communication through-put.

Table 2-1 Link Budget (El = 45°)

	Up Link 43GHz	Down Link 38GHz
Transmit Power (W)	1.0	0.7
Antenna Diameter (m)	0.3	0.4
Antenna Gain * (dB)	38.4	37.3
EIRP (dBW)	38.4	35.7
Path Loss (dB)	216.7	215.6
Absorption Loss (dB)	2.5	1.7
Pointing Loss (dB)	1.0	1.0
Antenna Diameter (m)	0.4	0.3
Antenna Gain * (dB)	38.6	37.8
Receive Power (dBW)	-143.2	-144.8
System Noise Temp. (K)	970	580
No (dBW/Hz)	-198.7	-201.0
C/No (dB·Hz)	55.5	56.2
C/No needed (dB·Hz) (PSK BER=10^{-4}, Data Rate: 64kbps, Coding Gain: 4dB)	52.5	

* Feeder loss is included

Beam preassignment and demand assignment examination.

iii) Experimental hub station system

- Information recording and exchanging system.
  Computer hardware and software.

iv) Small earth terminal system

- Small antenna system allowing simple beam capture.
- Small transmitter and receiver facilities.
- Small information exchange terminal.

2.5 EXPERIMENT SCHEDULE

The on-board equipment has been developed up to the stage of the electrical model at present. After the specified electrical tests, most of the electrical model will be refurbished for on-board use.

The ETS-VI is now planned to be launched in 1993, one year later than the original schedule. The satellite will be used for inter-satellite communications experiments and the basic experiment for the personal satellite communications on the millimeter-wave for two years. Various application experiments are also planned to be carried out afterward.

The experiment introduced here is to be conducted after 1995 as one of the application experiments. It is expected that the cooperative study by researchers in the Asia-Oceania including Japan will be conducted.

3. ON-BOARD MILLIMETER WAVE COMMUNICATIONS EQUIPMENTS

3.1 SYSTEM CONFIGURATION

The experimental system in space segment, as shown in Figure 3-1, is composed of a millimeter-wave antenna (40cm in diameter), a millimeter-wave transponder, feeder link transponder (30/20GHz band) and two large antennas (4), (5).

The millimeter-wave antenna and the millimeter-wave transponder are mounted on the gimbal platform which can turn the millimeter-wave antenna to anywhere with the global service area within the ground command.

The transponder allows two operation modes of the millimeter-wave loop-back mode and the millimeter-wave/Ka-band cross mode. In the millimeter-wave loop-back mode, the transponder receives 43GHz band signals from earth terminals and outputs the signals in 38GHz band. In cross mode, received 43GHz band signals are transmitted in 20GHz band signal from the feeder link transponder, and 30GHz

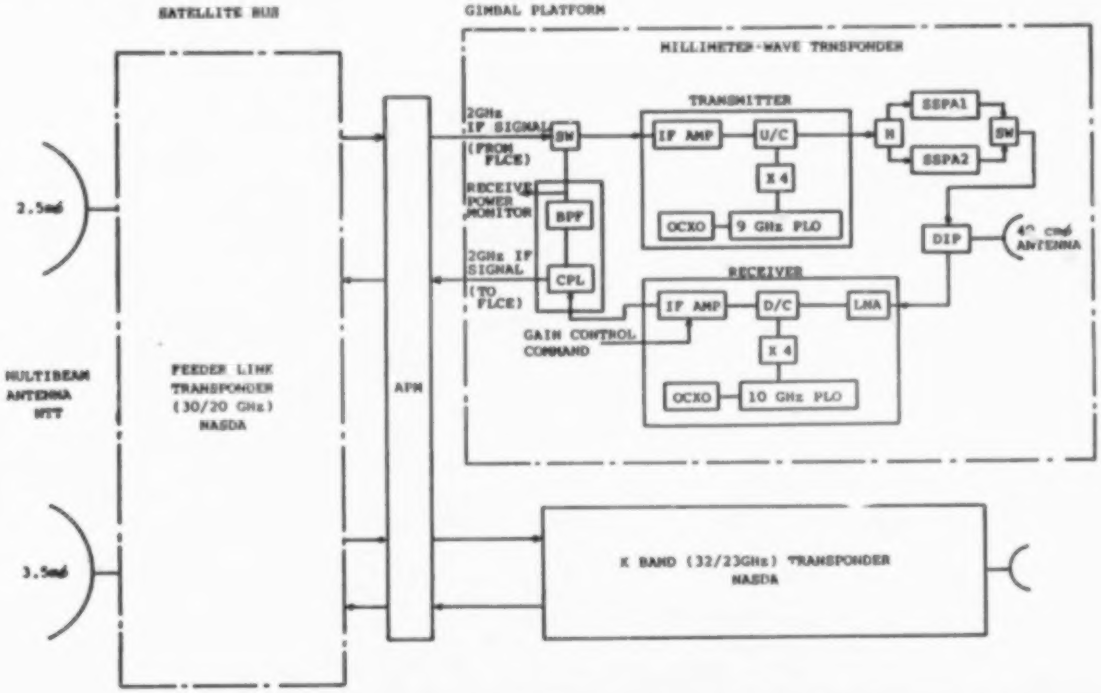

SATELLITE BUS
GIMBAL PLATFORM
MILLIMETER-WAVE TRNSPONDER
TRANSMITTER
RECEIVER
2GHz IF SIGNAL (FROM FLCE)
RECEIVE POWER MONITOR
2GHz IF SIGNAL (TO FLCE)
GAIN CONTROL COMMAND
SW
BPF
CPL
IF AMP
U/C
X 4
OCXO
9 GHz PLO
H
SSPA1
SSPA2
SW
DIP
40 cmϕ ANTENNA
D/C
LNA
10 GHz PLO
2.5mϕ
3.5mϕ
MULTIBEAM ANTENNA NTT
FEEDER LINK TRANSPONDER (30/20 GHz) NASDA
APM
K BAND (32/23GHz) TRANSPONDER NASDA

FIGURE 3-1. CONFIGURATION OF ETS-VI ON-BOARD MM-WAVE SATELLITE COMMUNICATIONS EXPERIMENTAL SYSTEM

band signals received at the feeder link transponder are transmitted in 38GHz band, in the oppsite way.

3.2 MILLIMETER-WAVE TRANSPONDER

The transponder, as shown in Figure 3-1, is composed of: a diplexer, a 43GHz band receiver including a Low Noise Amplifier(LNA), an IF section including an IF coupler and an IF filter, an IF switch for operation mode selection, a transmitter for frequency conversion a 38GHz band hybrid, two 38GHz band Solid State Power Amplifiers (SSPA) for primary and redundant use, and a 38GHz band waveguide switch for SSPA selection.

3.2.1 DIPLEXER

The diplexer supplies a reception signal from the antenna to the receiver and a transmission signal from the power amplifier to the antenna. It is required to have high isolation between the transmitting and receiving routes as well as low loss in each route. A wave-guide circuit provides the insertion losses of 0.6dB and 0.55dB in the transmitting and the receiving routes, respectively. The isolation between the transmitting and receiving routes is 95dB or more.

3.2.2 RECEIVER

The first stage of the 43GHz band receiver is a low noise FET (HEMT) amplifier, which has a noise figure of 5.6dB or less and a gain of 25dB. The performance and configuration of the low noise amplifier are shown in Table 3-1 and Figure 3-2, respectively.

The LNA consists of wave-guide isolators and an amplifier modules. The amplifier module is fabricated by the HIC technique and has three-stage cascade-connected HEMT chips, the gate of which is 0.3um in length and 100um in width.

The gain of the IF amplifier section can be selected within 30dB in 2dB step by the ground command.

3.2.3 IF SECTION

The IF section consists of a 2GHz band coupler distributing the received signal to both the millimeter-wave loop-back route and the feeder link route and a band pass filter.

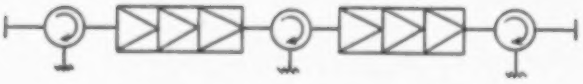


FIGURE 3-2. CONFIGURATION OF LOW NOISE AMPLIFIER

Table 3-1 Major Performance of LNA

	Item	Performance
1.	Frequency	43.0 ±0.05 GHz
2.	Gain	25 dB
3.	Noise Figure	5.2 dB
4.	Power Consumption	0.25 W
5.	Weight	195 g

The band pass filter with 1.2MHz band width is designed to inprove the signal to noise ratio in the millimeter-wave loop-back mode so that the output power is not saturated with noise power when a low level input signal is received from the personal small earth terminal.

3.2.4 LOCAL OSCILLATOR

In such a small capacity communication system as the personal communication, it is necessary to improve the transponder frequency stability and suppress the phase noise as far as possible.

A 10GHz band phase locked oscillator (PLO) excited by a 60MHz Oven-controlled Crystal Oscillator (OCXO) is employed for the local oscillator of the receiver and the transmitter. The PLO output frequency is quadrupled to obtain 41GHz or 36GHz band local signals.

3.2.5 38GHz BAND SOLID STATE POWER AMPLIFIER

An FET amplifier, using a newly developed GaAs MES FET, is employed. The configuration of the SSPA is shown in Figure 3-3.

This SSPA is separated into two blocks; an FET amplifier and a power supply (PS) to prevent interference from each other. The construction is a stack type structure is adopted to minimize the foot print of the SSPA component. All amplifier

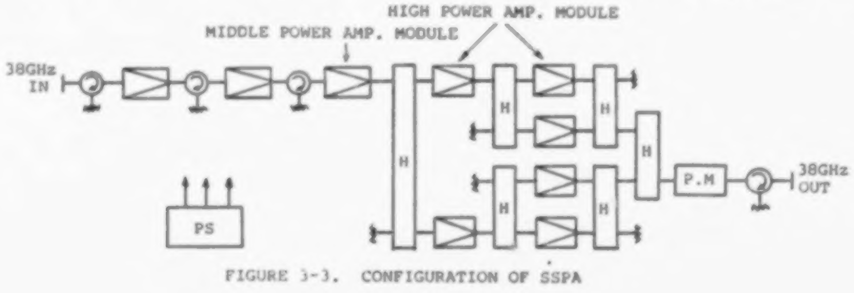


FIGURE 3-3. CONFIGURATION OF SSPA

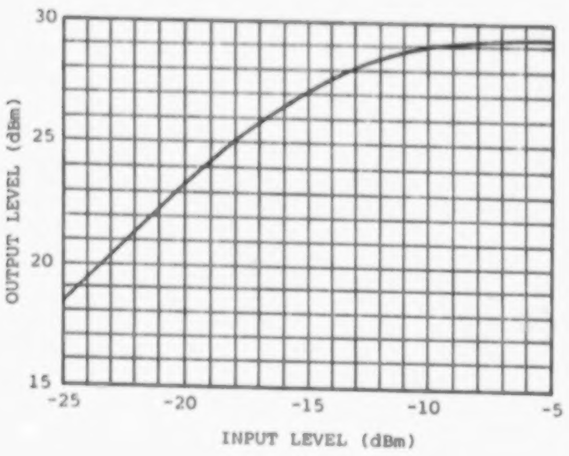


FIGURE 3-4. SSPA INPUT-OUTPUT LINEARITY

modules, as shown in Figure 3-3, are fabricated by the HIC technique. Four modules at the final stage work in parallel to get the required output level.

The input-ouput lineality of SSPA is shown in Figure 3-4. As shown in Figure 3-4, the saturation output power of 0.8 watts or more is obtained.

The performance of component units and the millimeter-wave transponder are summarized in Table 3-2. The power consumption is 31.5 watts or less, and the total weight except the antenna is 9.7kg. Figure 3-5 shows the millimeter-wave transponder electrical model for over-all performance test.

4. CONCLUSION

Described above are the millimeter-wave communication experimental plans with the ETS-VI and the performance of the millimeter-wave transponder mounted on the ETS-VI. We are going to develop the on-board model based on the system evaluation of the ETS-VI and the millimeter-wave personal small earth terminal.

Table 3-2 Performance of MM-Wave Transponder

Item		Requirement	EM Performance
Frequency	Receiving	43 GHz	
	Transmitting	38 GHz	
	IF	1.98 GHz	
Diplexer	Insertion Loss (TX)	0.8 dB or less	0.6 dB
	Insertion Loss (RX)	0.8 dB or less	0.55 dB
	TX-RX Isolation	90 dB or more	95 dB
Receiver Noise Figure		6 dB or less	5.6 dB
Power AMP.	Saturation Output Power	0.5 W or more	0.8 W
	Linear Gain	41 dB or more	43.5 dB
	Power Consumption	22 W or less	16.8 W
Local Oscillator	Frequency Stability	$\pm 3 \times 10^{-7}$ or less	$\pm 1.7 \times 10^{-7}$
	Phase Noise	-75 dBc/Hz or less (1kHz offset)	-79 dBc/Hz
	Output Power	+12 dBm or more	13 dBm
Weight		11 kg or less	9.7 kg
Power Consumption		41 W or less	31.5 W

5. ACKNOWLEDGMENTS

The authors would like to thank to NASDA and the related personnel for their help in developing this system.

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FIGURE 3-5. MILLIMETER-WAVE TRANSPONDER

INTELSAT: THE NEXT 25 YEARS AND BEYOND

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ABSTRACT

INTELSAT focuses its energy in preparing to take on near- and long-term demands and future challenges anticipated in the world's telecommunications arena, with special attention given to the diverse user requirements in the Pacific Basin. With its multiple strengths and advantages, INTELSAT is positioning itself to remain the major supplier of the region's telecommunications needs.

I. INTRODUCTION

INTELSAT, in August 1989, proudly celebrated its 25th anniversary. INTELSAT's 25-year history reflects its landmark achievements and success in providing the world's largest commercial satellite communications network, and its countless contributions to the progress and growth in the world's telecommunications development.

As we move into the last decade of the twentieth century, telecommunications have reached a critical threshold. New user requirements are demanding a new set of services; continuing growth in technology is allowing users more flexibility and more efficient use of the telecommunications systems. At the same time, an increasing number of fiber optic cable lines such as the recently commissioned TPC3/HAW4 pacific cables are being constructed to link nations, regions and continents; satellite communications for domestic, regional and international networks are being offered through various existing and new satellite systems while an increasing number of planned satellite systems, separate from the INTELSAT system such as ASIASAT and PACSTAR are also making news.

How does INTELSAT fit into this situation? With the cooperative efforts of its over 170 members and users, and as the world's largest telecommunications systems operator and leader of service providers for 25 successful years, INTELSAT has anticipated these changes and is at the forefront in responding to this new competitive environment. The many ways in which INTELSAT is adapting to this rapidly changing telecommunications environment include: technological improvements to its satellites; expanded system flexibility; innovative service offerings; resource-based tariffing and strengthened customer relations. INTELSAT is continuously reexamining every aspect of its global commercial satellite system and its service offerings to ensure that the INTELSAT system is responsive to the wants and needs of INTELSAT's members and users. I will describe a few of these efforts which are intended to ensure that INTELSAT survives the challenges from fiber optic cables and alternate satellite systems and the next 25 years and beyond are as successful for INTELSAT as the last 25.

II. INTELSAT'S STRENGTHS

1. INTELSAT Is An Established International Cooperative Organization

INTELSAT's success as an international organization is the result of a well conceived structure designed to balance principles of commercial operation with those of international cooperation. It has been successful in managing a high technology enterprise in outer space and has the flexibility to continue to respond to a changing international telecommunications milieu.

There is one unique distinction that sets INTELSAT apart from other international ventures and that has been key to INTELSAT's success over the past 25 years--INTELSAT is an organization with a tangible mission. That mission is the establishment of a global commercial communications satellite system that provides expanded telecommunications to all areas of the world. It is this mission to which all of INTELSAT's members and users have made a strong commitment, and it is this mission and their commitment to it that shapes each member's participation in the organization. The fulfillment of this mission dictated an expedient and pragmatic approach to the organization's structure and the roles that the member nations would play within this structure. This structure includes a tripartite governing arrangement of an Assembly of Parties, those nations which have signed the INTELSAT Agreement and which meet on an ordinary basis every two years to consider those aspects of INTELSAT which are primarily of interest to them as sovereign states; an annual Meeting of Signatories, those entities which have been designated by the Parties to sign the Operating Agreement of INTELSAT; and a Board of Governors meeting on a quarterly basis. The Board of Governors is composed of approximately twenty members representing those Signatories or group of Signatories having a system utilization above a minimum level set annually by the Meeting of Signatories and in addition, Governors representing at least five (5) Signatories from any one of the ITU regions who are not otherwise represented on the Board of Governors.

This structure has proven to be quite successful in giving all of INTELSAT's members a voice in shaping INTELSAT's policies and plans and ensuring that the INTELSAT system remains responsive to the needs of all its members.

2. Advantages of INTELSAT's Economic and Financial Arrangements

INTELSAT operates as a not-for-profit cooperative, and its ownership is shared in principle among its members in proportion to their respective use of the system. The investment share determines each Signatory's percentage of the total contribution needed to finance capital expenditures and the portion of net revenues it receives. INTELSAT revenues come primarily from utilization charges and, after deduction of operating costs, are distributed to Signatories in proportion to their investment shares as repayment of capital and compensation for use of capital.

A key precept is universal access through the provision of services on a non-discriminatory basis. All users of the system, whether or not members, pay the same rates for the same service. These concepts of economies of scale have worked exceedingly well over INTELSAT's lifetime and should continue to operate effectively in the years ahead.

3. Worldwide Network

A. Interconnectivity

INTELSAT global satellite system provides worldwide interconnection with a wide range of telecommunications services reliably and cost effectively, using the most advanced state-of-the-art technology. The INTELSAT system has grown from the single pathway provided by INTELSAT's first satellite, Early Bird, to the more than 2,000 earth-station-to-earth-station links provided through INTELSAT's current fleet of satellites. It follows therefore that with its ability to meet both international and national needs, INTELSAT is uniquely qualified to meet the diverse range of communications requirements of the Asia and Pacific region, as well as those of the entire world.

B. INTELSAT V's

The INTELSAT fleet of satellites consists of thirteen INTELSAT V and VA satellites and one INTELSAT VI satellite. The INTELSAT V program has been extraordinarily successful. The thirteen INTELSAT V spacecraft now deployed provide the bulk of INTELSAT's in-orbit capacity. The growth in communications capability provided by the INTELSAT V's has enabled INTELSAT to satisfy the steady increase in user demand and to develop new types of services in response to new opportunities. The greater capabilities of the INTELSAT V satellites ushered in an unprecedented era of new service applications and more flexible earth station configurations. These service applications have made possible widespread introduction of digital technology and the world's first globally available offerings compatible with evolving standards for an Integrated Services Digital Network (ISDN).

C. INTELSAT VI

The INTELSAT V satellites are now becoming saturated, and INTELSAT has begun the deployment of its next generation INTELSAT VI satellites. The first of five INTELSAT VI satellites was recently launched on 27 October 1989. INTELSAT initiatives in the application of digital technology achieved another milestone with the launch of INTELSAT VI and the impending first commercial use of satellite-switched TDMA (SS/TDMA). SS/TDMA will give INTELSAT users greater flexibility in configuring their networks. Based on current schedules, this system will become operational in the Atlantic Ocean Region in April 1990 and in the Indian Ocean Region approximately four months later. However, for a brief period in December 1989, in-orbit testing of the first INTELSAT VI was interrupted in order to provide live TV coverage of the historic Summit between President Bush and Mr. Gorbachev in Malta. INTELSAT VI on-board switching will enhance network connectivity and make possible more efficient use of capacity. Both these features should permit savings in terminal and earth station hardware.

D. INTELSAT VII's

Even as INTELSAT begins deployment of the new INTELSAT VI satellite, it is preparing for their successor, the INTELSAT VII series of satellites. On 4 October 1988, INTELSAT awarded a contract to a group led by Ford Aerospace Corporation (FAC) for delivery of five INTELSAT VII satellites with options for procurement of up to a total of nine additional satellites. The launch of the first INTELSAT VII is scheduled for 3rd quarter 1992 with deployment in the Pacific Ocean Region.

The INTELSAT VII series is noteworthy for its flexible operation. INTELSAT users will have a high quality service that can be tailored to their specific needs. INTELSAT VII spacecraft can be configured to meet different traffic requirements without sacrificing usable capacity, thus allowing high satellite capacity fill. INTELSAT VII satellites are conducive to use with both larger (Standard A and C) and smaller (Standard E and F) earth stations. INTELSAT VII's utilization of the most advanced technology will also provide significant improvements over its predecessors in terms of coverage, communications capacity, command and control procedures, and orbital maneuver life.

4. System Sparing Philosophy

INTELSAT takes pride in its system planning to ensure its user service continuity and system redundancy. System sparing is emphasized as essential to operational service, quality, reliability and security.

The INTELSAT system today is configured with one spacecraft at 332.5E, carrying only preemptible services, which could be relocated in response to a permanent failure of one of the other spacecraft. In fact, the system does not rely solely upon this one satellite. In order to accommodate the need to have a virtually instantaneous response to a total spacecraft failure in all three ocean regions without disruption of the active leases on the 332.5E, it is recognized that the system sparing capability includes not only the resources at 332.5E, but also the resources at 359.0E, 66.0E, 177/180.0E and any other capacity that can be utilized. The specific, agreed, plans for contingency are regularly updated with the users in each region. The current system clearly results in the permanent off-loading of some preemptible service in the event of a complete failure in the 1990s of an in-orbit operational satellite.

To ensure continuation of future spare satellites, INTELSAT is considering a proposal to acquire additional INTELSAT VII satellites. The first available VII, after the Pacific region requirements and any other urgent requirements were satisfied, would be located in the Atlantic ocean region as a dedicated empty system spare. It would be used for pointover restoration of any major satellite failure in the Atlantic. In the event of a failure of an INTELSAT VI, the dedicated spare INTELSAT VII would replace the appropriately configured VI, and that VI could in turn replace any other failed VI with full capability.

In the event of a failure in either the Indian or Pacific ocean regions, pointover restoration would be implemented to inclined orbit satellites in those regions, together with any other short term reconfigurations which are appropriate and achievable. Meanwhile the dedicated spare would be moved at a very rapid rate to replace the failed satellite.

5. System Reliability

Various operational networks are integral to the service reliability of the INTELSAT system. These include the tracking, telemetry, command and monitoring network (TTC&M), the network of control and coordination circuits (CCC) that link the INTELSAT Operations Center (IOC) and the Spacecraft Control Center (SCC) with INTELSAT earth stations, and the Time Division Multiple Access reference monitoring system network (TRMS). The goal of these networks is continuous and reliable system operation.

In addition, an earth station will be located at INTELSAT headquarters to provide direct communications with INTELSAT TTC&M stations around the world. This antenna will be the first INTELSAT-owned, non-experimental earth station since the organization was established 25 years ago.

III. INTELSAT COMPARES FAVORABLY WITH FIBER OPTIC CABLES

The changing world telecommunications market is adding yet another facet to the issue of which technology can better serve world telecommunications demand. Not only is overall demand growing, but also, the patterns of world demand are changing and becoming more diversified.

How will INTELSAT compete in this environment? Will fiber optic technology tip the scales in favor of undersea cables as the most desirable way to meet world telecommunications demand? We at INTELSAT think not, because cables, fiber or otherwise, basically can function only as point-to-point transmission facilities. Satellites, on the other hand, have the advantage of operating in a point-to-point mode, in point-to-multipoint networks, and in multipoint-to-multipoint networks. Additionally, satellite networks can expand, contract, and be reconfigured to respond to changing demand. They can avoid losses in service due to failures in any single network node. Because of their point-to-multipoint capability, satellites are also ideal for television distribution.

Contributing to changes in the world telecommunications market are changes in how domestic telecommunications are routed. Fiber optic technology is being utilized on an expanded scale for domestic local area and long distance networks. These domestic fiber networks may pose a competitive challenge for domestic satellite systems, but for INTELSAT they represent potential opportunities for expanding access to our network and bringing our services closer to customers.

Fiber optics represent both a challenge and an opportunity for INTELSAT in developing competitive strategies. For INTELSAT to be competitive in the world telecommunications market, it has developed services and tariffs that enhance its natural capabilities while meeting the needs of users with heavy traffic requirements cost effectively. INTELSAT has a broad-based strategy to accomplish these objectives that is designed to capitalize on its strengths; use existing and planned resources more efficiently and in new and innovative ways; introduce new operational and planning initiatives; and emphasize digital service capability and ISDN compatibility.

1. Restoring Submarine Cables

Clearly, INTELSAT is more than capable of responding to all foreseeable satellite demand, and even restoring fiber optic undersea cable systems. Indeed, INTELSAT offers a restoration service on eight (of 48) transponders of a single INTELSAT VI satellite for the fully loaded traffic of the TAT-8 cable.

During 1988, INTELSAT introduced additional restoration services for both wideband and analog cables on the INTELSAT satellites operating in inclined orbit in each ocean region. This new service replaces the previous INTELSAT offering for wideband cable restoration.

During 1989, INTELSAT introduced a restoration service specifically tailored for restoration of Pacific Rim wideband and analog cables.

Because the INTELSAT system consistently achieves 99.9 percent reliability, it routinely serves as back-up for cable systems. For the last four years alone, INTELSAT has restored almost one-and-a-half million channel days of submarine cable service. In 1988, INTELSAT restored nearly 10,000 cable circuits for a total of 165,600 channel days, generating revenues of U.S. $7.2 million. From January to mid-November 1989, INTELSAT provided a total of 156,890 channel days for cable restoration.

As the cables get larger, and as each one carries more traffic, INTELSAT's importance to its members for media diversity and for restoring failed cables increases. Our members reliance on INTELSAT for diverse routing and cable restoration was underscored in August 1989 when INTELSAT simultaneously restored six major submarine cables including the Transatlantic and TransPacific fiber optic cables, TAT-8 and TPC-3.

2. Multi-point Distribution

A unique feature of all communications satellites is their multi-access capability. Through its satellites in all three ocean regions, INTELSAT provides direct links among 170 countries through international and domestic networks. Satellites have the flexibility of operating as point-to-point facilities for heavy traffic routes and as point to multipoint for broadcast and data distribution services or multiple point to point for data collection services. While fiber optic undersea cables may employ branching to more than just one head-end, they will never approach the multi-access capabilities of satellites.

3. Cost Comparisons

Proponents of cable will quickly retort that use of fiber will render use of satellites for major trunk routes costly and uneconomic. As you know, INTELSAT has strongly disputed this claim. INTELSAT is cost-efficient. The companies who own fiber optic cables are often also the owners and users of INTELSAT. While not the sole decisional index, INTELSAT costs are attractive relative to fiber optic cable and will prove an important incentive to these companies to continue to make heavy utilization of the INTELSAT system.

4. Economic and Technological Advantages of Satellites

Recurring assertions that satellite facilities are inferior to cable systems because of propagation delay inherent in transmitting 22,500 miles up to the satellite and back to the earth's surface are clearly outdated. Developments in echo cancellation technology have virtually eliminated the delayed echo associated with voice transmission carried on satellites. In addition, delay compensation units have been developed for data transmission via satellite. This has resulted in extremely satisfactory satellite data services.

The list of satellite advantages continues. Satellite have the advantage of scope, as well as economies of scale, given their broad geographic coverage and ability to interconnect numerous diverse locations. The growing use of digital transmission techniques, combined with satellites' multiple access capabilities, make it possible for satellites to provide services closer to customer premises and to bypass traditional telecommunications routes. With INTELSAT's higher powered satellites and smaller earth station options, it is no longer necessary to aggregate all traffic at large international gateway earth stations. It is now economic to access the INTELSAT network directly via an urban or suburban node.

5. Charging

Despite these economic and technical advantages of satellites, administrations often turn to cables over satellite because of the way in which cable circuits are acquired. Typically, an administration makes an initial investment for its use for the lifetime of a cable. In contrast, in the past, satellite capacity has been acquired on an as-needed basis. Because this cable investment represents costs which are sunk at the beginning, there is an incentive to fill acquired cable capacity as quickly as possible, often resulting in a decision to carry traffic on cable even though a satellite circuit may be more economical. In order to overcome this potential bias, INTELSAT has instituted new tariff structures which offer substantial discounts for five-, ten- and fifteen-year commitments for satellite capacity. Such commitments are intended to obviate any bias towards cables resulting from sunk investments by encouraging administrations to view their satellite capacity needs on a longer term, as well as to help INTELSAT to better match its planned capacity with user requirements.

IV. OPERATING IN A MORE COMPETITIVE ENVIRONMENT

INTELSAT is also very aware that it is operating in a very different environment today from that which existed 25 years ago--one that is far more competitive, and that will remain so in the years ahead.

1. INTELSAT's Strategic Plan

In recognition of this fact, INTELSAT and its Signatories have been engaged in a serious process of evaluation, analysis of the developments that affect its markets, and reassessment of its objectives and the steps necessary to achieve them. The result has been the development of a strategic plan that has been endorsed by INTELSAT's Board of Governors, Meeting of Signatories and Assembly of Parties. This plan provides an integrated framework for the organization's activities and focuses energies on improvements and INTELSAT's strengths.

Through its strategic planning process, INTELSAT is focusing on ways to ensure that its services remain attractive and competitive for all users and is pursuing this goal on all fronts--operational, technical, economic. The key elements for achieving this goal are already in place. INTELSAT VI and VII spacecraft, providing service through the year 2000, are the nucleus of the INTELSAT system in the years to come. Application of digital technology will continue to play a primary role in the INTELSAT system of the future. Progress is being made toward the goal of conversion from an analog to a digital network in the 1990s, as the result of INTELSAT's initiatives in service, assistance and charging.

2. Recent Improvements

INTELSAT has continuously pursued the application of advanced technology to enhance the benefits of using the INTELSAT system. INTELSAT initiatives in companding, digital speech interpolation, and digital circuit multiplication equipment have resulted in impressive progress in signal modulation. Digital modulation techniques are currently being developed for television transmission and will allow substantial performance improvement.

New access methods also have been developed, such as TDMA and satellite-switched TDMA introduced on INTELSAT VI. For thin-route traffic requirements, demand assignment access procedures have been developed and are now reaching maturity.

3. Digital Services

A continuing focus for INTELSAT both now and in the future is the Integrated Services Digital Network (ISDN). Satellites can provide high digital capacity compatible with ISDN standards, and users will benefit from satellite networks which are well known to their broadcasting capacity, their network flexibility, their minimum implementation times and low costs. Furthermore, satellites will facilitate the rapid and wide spread implementation of ISDN; in fact, on the international level, the only way to obtain ISDN services today is through INTELSAT satellite facilities. In particular, it is possible in three ways: the INTELSAT Time Division Multiple Access Services (TDMA); IDR or Intermediate Data Rate carriers; and Super IBS.

Super IBS is an evolution of K-band IBS with an upgraded ISDN performance to meet the most stringent needs of the business community. IDR carriers are the digital equivalent of the FDM/FM network. The IDR system transmits digital (QPSK) carriers ranging from 64 Kbps to about 140 Mbps. Although designed primarily for international public-switched telephony service, IDR can carry a full range of voice, data and video transmissions.

4. IDR Service

Widespread implementation of IDR is key to INTELSAT's goal of digital conversion. IDR offers integrated digital communications with ISDN quality performance standards. Service is available via earth stations with antennas as small as 5.5 meters in addition to the large INTELSAT gateway earth stations. IDR is offered on a bearer channel basis. This means that each IDR channel can be used to derive multiple channels using Digital Circuit Multiplication Equipment (DCME) to achieve much lower per-channel cost to users.

5. Regional Services

In March 1989, INTELSAT approved the use of conventional domestic lease or Planned Domestic Service (PDS) capacity for certain two-way transborder services, mainly for thin-route applications. In these cases, the lessee or PDS holder would pay no extra charge, but the non-lessee or non-PDS holder participating in the international use would pay the full tariff for the service. INTELSAT also authorizes a transition plan to ease the conversion of leases from domestic to regional use. Both these decisions give domestic users greater flexibility to use the INTELSAT capacity they have to expand regional communications. Beginning 1 January 1990, INTELSAT is offering for the first time Transponders for Unrestricted Use (TUU). This offering permits a single transponder to be used for both domestic and international service at the option of the user and provides even greater flexibility in the use of satellite capacity.

6. High-Quality, Low-Cost Service for Low-Density Traffic

INTELSAT's mandate is provision of service to all areas of the world, regardless of the size of their traffic requirements. The Vista Service was developed to meet the needs of INTELSAT users with low density traffic, particularly in isolated and remote communities. Both voice and low speed data communications can be provided with Vista. Super Vista is an option available to Vista networks under the control of a Demand Assigned Multiple Access (DAMA) system. It is tariffed at lower per-channel unit rates than basic Vista to reflect the more efficient utilization of the INTELSAT space segment provided by the DAMA equipment. By 31 December 1988, there were 160 Vista channels in service in all three ocean regions. This represented a 25 percent increase over the previous year. As of mid-December 1989, the total number increased to 342 Vista channels in service.

7. Tariff Reductions

Reducing the costs of INTELSAT services is a continuing objective of INTELSAT operations and one of the areas where INTELSAT's record has been superior. INTELSAT has and will continue to develop a charging structure that is responsive to the goal of providing the most efficient and economic telecommunications facilities possible. INTELSAT seeks to achieve this objective by aligning rates with the economic cost of providing each service.

It is clear that INTELSAT is moving aggressively to develop more competitive rates. This process began two years ago with the implementation of bearer channels and tariff incentives for digital services and long-term commitments; bulk capacity leases and capacity for unrestricted use. It is continuing with the focus on more resource-based pricing and development of new charging concepts to reflect this approach.

V. CONCLUSION

INTELSAT's experience and success has helped foment a changed telecommunications environment. These achievements, combined with the program initiatives already underway, make INTELSAT a strong contender in the global telecommunications arena. INTELSAT is continuously seeking new and better ways to meet the objectives of its mission of providing expanded communications services to all areas of the world. Its first 25 years have been extraordinarily successful in bringing to the world greatly improved communications services, and the key elements for enhancing the role of INTELSAT global satellite system in the competitive environment of the 21st century are already in place.

Session 3.2

Networks I

NOTES

Hybrid Networks in the Pacific Ocean Region

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1. ABSTRACT

International telecommunications facilities are offering more and more options to access business centers on the Pacific Rim. Opportunities to fully exploit these new links by commercial and government organizations require further work in deregulation and in providing means of assuring network security on the part of telecommunications and government administrations.

2. INTRODUCTION

Six years have elapsed since the breakup of AT & T, an event that heralded a new era in telecommunications in the United States. Today we're seeing deregulation and liberalization spreading to include international telecommunications. Among the benefits that have already accrued to users of international services are rate reductions driven by competition and technology, and the availability of alternative routings offered by independent fiber optic cable and satellite operators that compete directly with the traditional carrier-provided facilities.

In previous Pacific Telecommunications Council forums, Pacific Telecom Cable and others have extolled the benefits that this new competitiveness has brought in terms of connectivity, reliability, lower rates and service options. With each passing year, the ability of long-haul and regional networks to accommodate more and more traffic grows. The expansion of digital facilities is well-timed, and is coincident with the also well-documented expansion of commerce in the Pacific Basin, which is now the center of gravity for world economic growth.

In our presentation today, Pacific Telecom Cable will urge that carriers and administrations serving the Pacific Basin look ahead to new opportunities that will present themselves as these new, high-capacity digital facilities come on line. We believe that these opportunities lie in what can be termed hybrid networks. Such networks can be established either on a long-term or ad hoc basis to meet the specific requirements of manufacturing, financial and service companies and the media, both to execute normal activities more cost effectively and to develop innovative applications. The need to facilitate the establishment of such networks is now, and calls for the cooperation and understanding not only of carriers and administrations, but also appropriate government agencies, the technical community and major customers.

3. THE HYBRID NETWORK

When we reviewed the PTC '90 Call for Papers, the subject of hybrid networks caught our eye, but there was a question as to a precise definition of such networks. Are they a mixture of satellite and cable? Analog and digital transmissions? Public and independent facilities? Switched and non-switched? In a conversation with the Council, we agreed that it could be any or all of these. Perhaps it is expressed best as a networking environment that permits the user to combine the necessary facilities in whatever way is needed to get a job done.

In U.S. telecommunications, the term hybrid network could be synonymous with a custom network -- one that is designed to satisfy the unique requirements of any specific user or user group. In the United States, essential technical and regulatory mechanisms are in place to permit the efficient establishment of a hybrid network. These are:

- o Standardized Transmit/Receive Parameters
- o Rights to Private Encryption
- o Rights to Transmission Capacity Ownership
- o Rights to Direct Satellite/Cable Access

Within the United States, then, a hybrid network can also be a private network or an applications-driven network. It can utilize satellite or terrestrial links to connect nodes on a permanent or ad hoc basis. It can include leased or owned facilities, and can use analog or digital transmissions. And important for many applications, it can be encrypted.

We encourage this concept to be embraced internationally by carriers and administrations because we believe that it will help unleash tremendous new opportunities to enhance the design, production and distribution process of international economies and commerce. It will also help reduce costs for military and government agency networks. Revenues for carriers will increase from the resultant expanded use of communications facilities.

4. THE NEED

At a recent Asia-Pacific Defense Conference sponsored by the Armed Forces Communications and Electronics Association, Robert Bolam of the Boeing Company called attention to the need to extend telecom deregulation and liberalization in the Pacific Rim beyond the provision of alternate carriers. Focusing on the benefits to the aerospace industry, Mr. Bolam said that the Pacific/Asian basin, including Japan, accounts for nearly 25 percent of the commercial airplane business for Boeing, and that projected revenues from this region between 1989 and 2005 amount to $516 billion.

Noting that the name Boeing is synonymous with service in the jet transport industry, Mr. Bolam stated that his company is planning to support its overseas customers with a highly sophisticated communications system. To implement this system (as well as others that are required if we are to take full advantage of the communications capacity in the Pacific) will require some new thinking on the part of our industry.

For example, and I quote directly from the Boeing presentation, "We look to network suppliers; local, national and international governments, their communications agencies and businesses for assistance in developing communications gateways with switchable data rates ranging from 768 kbit/s down to 64 kbit/s. Although (the Boeing) codecs can provide approved encryption for general business conferences on a limited secure level, the future will demand higher levels of encryption on the networks for increased commercial and government use."

The company says that acceptance of approved encryption devices for "offbase" government applications is important for business in the Pacific-Asian market. Without National Security Administration-approved end-to-end encryption, subject material can be no more "confidential" than exchanging weather forecasts.

Finally, there is the need for on-site access. Mr. Bolam states that "Boeing seeks network capability that not only will accept our customers' security standards, but also provide reliable back-up systems, individual site connectivity control, and network usage management systems." Specifically, he says that "our international usage to this point has been limited due to vendor encryption devices at their gateways, 48-hour reservation processes and critical time zone differences."

We of the Pacific Telecommunications Council can do little about time zone differences. But I do belive that we can address many of the concerns voiced by Boeing...concerns, I am convinced, that would be echoed by other major multinational corporations if asked.

Indeed, last March the subject was addressed by Jonathan Solomon of Cable and Wireless in the Sir Eric Eastwood Commemorative Lecture before the Institution of Electrical Engineers. In his presentation, he said that the achievement of a 21st century telecommunications infrastructure by the year 2000 will require regulatory changes promoting, among other things,

- A personal communications number recognizable for billing purposes anywhere in the world -- much like today's credit cards;
- individual access to global networks;
- an end to artifical boundary lines between national and international communications;
- a blurring of distinctions between business and residential exchange lines, and
- a mix of subscription and pricing aimed at maximizing service menus and customer usage of networks.

Mr. Solomon also calls for a reformation of the international telecommunications institutions such as the ITU, ISO, IEC and others so that their pace of standard-setting catches up with the pace of technological changes. Otherwise, he says, we may see a regrowth of regional standards rather than the promulgation of international standards -- in short, trade barriers of the information age. The negative impact of such barriers has not been lost on the administrators of the General Agreement on Tariffs and Trade.

5. INITIAL VICTORIES - FUTURE OPPORTUNITIES

Progress is being made on some fronts toward implementation of hybrid networks. The CCITT, for example, has announced standardized algorithms for codecs, scheduled to be implemented this year. This standard, commonly known as (P x 64), will provide users with the ability to transmit and receive at both high and low-end bandwidths, and maintain the industry standard for picture resolution in videoconferencing.

Regulatory bodies in the U.S., the U.K. and Japan are also moving toward the goals of 21st century communications. The European Economic Commission efforts, the outcome of the Melbourne World Administrative Telephone and Telegraph Conference and the new thinking inside many countries on the subject of liberalization and privatization suggest that these countries will be reviewing their own regulations in the light of progress already being made.

But there are additional opportunities available to encourage a fuller utilization of the growing capacity in the Pacific Ocean Region. We encourage telecommunications authorities to consider the benefits of private ownership of capacity on domestic and international facilities. We note that among the major countries around the Pacific Rim, not one outside the U.S. permits end-user ownership of domestic or international facilities, even though in many cases competing services are available in these countries. Moreover, while alternate international paths via cable and satellite are available, only the U.S. permits direct Intelsat satellite access by end users.

At the risk of sounding parochial, I believe we should look to U.S. experience as indicative of what results when unnecessary and sometimes arbitrary telecommunications regulations are removed. Prices drop, which encourages entrepreneurial thinking about imaginative new offerings in communications services, and in carrier-distributed entertainment. These in turn provide fertile ground for businesses formed to supply and support the new communications and entertainment services. And for the carriers, revenues rise because of the increased demand for communications capacity and general services.

As telecommunications suppliers and users in the Pacific Basin, we of the Pacific Telecommunications Council should take it upon ourselves to encourage a further reduction in the barriers to a fuller utilization of the high-capacity facilities becoming available to us over the next decade. Above all, we must work together to establish the environment that provides end users with the networking capability they need to operate most efficiently, and to serve their customers in the most effective manner.

With these goals accomplished, the mechanism for true hybrid networks will be in place. The result? Opportunities for international commerce will be enhanced, and the establishment of additional communications-related services and the facilities necessary to carry them will be encouraged.

May I suggest that we establish a working party to review the barriers to effective hybrid networking in the Pacific Basin and ask for a report before next year's meeting.

GATEWAY PROCESSOR FOR MULTIVENDOR NETWORK

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1. OUTLINE

Corporate information networks are becoming more and more important. It should be possible to connect machines made by different manufacturers in a network. Such a network is called a multivendor system. However,as networks become larger and more complicated, reliability becomes a major concern. Thus, companies must now make very reliable networks. To achieve this, we have developed a gate processor called a Communication Processing Node System (CPNS). This thesis outlines the CPNS and its effect.

2. OUTLOOK FOR MULTIVENDOR SYSTEMS

As companies expand their businesses and grow internationally, networks become increasingly important for activities such as finance, insurance, distribution, manufacturing, and imformation services. In this situation, the curreent disadvantages of networks may become fatal to companies.

Looking at the current status of corporate networks, the increasing number of business tie-ups and the growing scale of networks are boosting the trend toward multivendor systems and are making the connection of machines made by different manufacturers necessary in order to use the current host system and terminal resources in the most efficient way.
We need very reliable systems that will remain problem-free even when the network is complicated and extra terminals are connected. Further, various types of technologies will coexist in the 21st century, such as analog and digital communication lines and manifacturers' own communication protocols and standardized ones (for example, OSI).
Integrating these technologies presents a big proglem.

To connect machines made by different manufacturers, users had to coordinate the manufactures and determime the connection specifications by themselves and spend a lot of time on system development.
A system developed in this way was available only for the user and not for other users.

As networks grow and diversify, network management has a lot of work to do to keep up with institutional and technological revolutions. For example, a series of processes from problem detection to recovery is hard to automate, requiring a network control system.

To satisfy the network requirements, we developed the CPNS as a node system to help users to add protocol conversion and other functions easily to their system.

3. OUTLINE OF CPNS (See Figure 3.1)

Computer networks in Japan have more communication protocols than other countries.
The reason there are so many communications protocols is because each manufacturer uses a different protocol, thus making it hard to connect machines made by different manufacturers.

Machines from different manufacturers are usually connected by matching their protocols or eliminating the protocol differences using a conversion unit.
The former type uses the protocol common to the machines(such as the international standard protocol,OSI).
The latter type uses a conversion unit.
The CPNS belongs to the latter type.
To be specific, the CPNS is a conversion unit for connecting a terminal not supporting the OSI protocol to an OSI network.

The CPNS is very suitable for the present situation in Japan. In the future, it should become an essential product for the international network market. As a network gateway, the CPNS has the following characteristics :

(1) Network flexibility

- Various protocol conversion functions to connect machines made by different manufacturers
- Interface enabling users to build in their unique processing programs according to their operating system
- Transfer priority processing function to set work or user priority
- Host selection service to automatically select a host system from each terminal for each job

(2) Network high reliability

- Quick recovery from node problems
- Automatic switching to a backup line problem

(3) Network control

- Centralized monitor of distributed CPNSs at the control center
- Configuration and statistical information to create an optimum network layout and facility plan
- Remote control from the control center for unattended CPNS operation
- Operation and maintenance cost reduction by centralized control and unattended operation

4. CPNS APPLICATION SYSTEMS

The CPNS can be used either as a node to realize a high-reliability network (called mesh-nerwork CPNS) or a concentrator of many terminals (called access point CPNS).

(1) Mesh-network CPNS (See Figure 4.1)

The mesh-network is a system designed to achieve high reliability. The mesh-network CPNS adds intelligent functions (such as protocol conversion and user's unique processing) to high network reliability. The major services provided by the CPNS are party selection, protocol conversion, store-and-forward, automatic detouring, and network control. The CPNS will produce a cheap, reliable network and help the development of a complete system.

(2) Access point CPNS (See Figure 4.2)

The access point means a place from which a customer can access the network directly, such as a branch or sales office under control of the main office. From the viewpoint of a computer network, the access point is not the host computer but a terminal. The access point CPNS concentrates many terminals to reduce the line costs between the host system and terminals. Previously, a host system had to be stopped when extra terminals were connected. The CPNS, however, enables terminals to be connected to the network without stopping the host system. The major services provided by the CPNS are terminal concentration, protocol conversion, and party selection.

5. CPNS FUNCTIONS

The CPNS provides the following two major types of functions :

(1) Communication protocol functions

① Protocol conversion function

The standard protocols in the computer market, such as OSI and the standard protocol of National Bank Association, for connecting machines made by different manufacturers.

② Host selection function (See Figure 5.1)

The CPNS provides each display unit with a uniform host selection screen view. To select and connect a host system from a terminal connected to the CPNS, you simply select an item on the screen.

③ Transfer priority control (See Figure 5.2)

The CPNS transfers data in business priority order. For example, if realtime processing that does not require a quick response start in a CPNS at the same time, priority is given to the realtime processing.

(2) Network control functions

① High network reliability (See Figure 5.3 and 5.4)

- The CPNS consists of duplicated hardware to protect it from hardware problems. If the current system suffers from a problem, the backup system is automatically switches on to support the system.
- If a line problem occurs in a network using the CPNS, the system automatically switches to the backup line or routes around the abnormal lines. These two functions assure quick recovery from a node or line problem.

② CPNS network control (See Figure 5.5)

The distributed CPNS can be remote-controlled from the centralized network control center, so operators are not needed at the remote-controlled CPNS (unattended operation). The control information includes accounting, performance, problems, configuration, and secrecy.

③ Easy to build in user application programs

Users can program their unique codes, host selection screens to the connected terminals, and unique terminal protocols in the CPNS. In addition, each user's unique view can be built in as the CPNS network control view.

Because of these functions, we think the CPNS will become the backbone of multivendor networks.

6. EFFECT OF CPNS APPLICATION

The CPNS can be applied according to the needs of the network.

This section explains the current problems, requirements, and effects of applying CPNS.

[Current problems and requirements]

- It should be easy to add more terminals to the network.
- Users who have networks based on leased lines want a system where the terminals are not affected by a system down.
- Users who have packet switching networks a system where a host system made by a different manufacturer can be accessed from a terminal.

[CPNS application effect]

- More hosts and terminals can be added easily.
- The network reliability improves.
- Each terminal can be used for more work if machines made by different manufacturers can be connected.
- The mesh-network CPNS enables a complicated network to be more complete.
- CPNS centralized network control assures quick recovery of a large-scale and complicated network.
- A uniform host selection screen view among all terminals makes terminal operation easy.

7. CONCLUSION

The rest of the 20th century and the beginning of the 21st century will be the age of analog and digital communications.

In the information processing field, many protocols will be standardized while terminal functions are further upgraded and incompatibility between equipment of different manufacturers worsens. So, communications protocols may be integrated but not the terminal functions. The greatest feature of the CPNS is that it can convert the attributes specific to each terminal to those of the other machine. A product or function for interconnection, such as the CPNS, is essential for establishing a global network.

The CPNS will solve the problems in the fields of communications and information processing with market and technical trend.

SERVICES PROVIDED BY CPNS

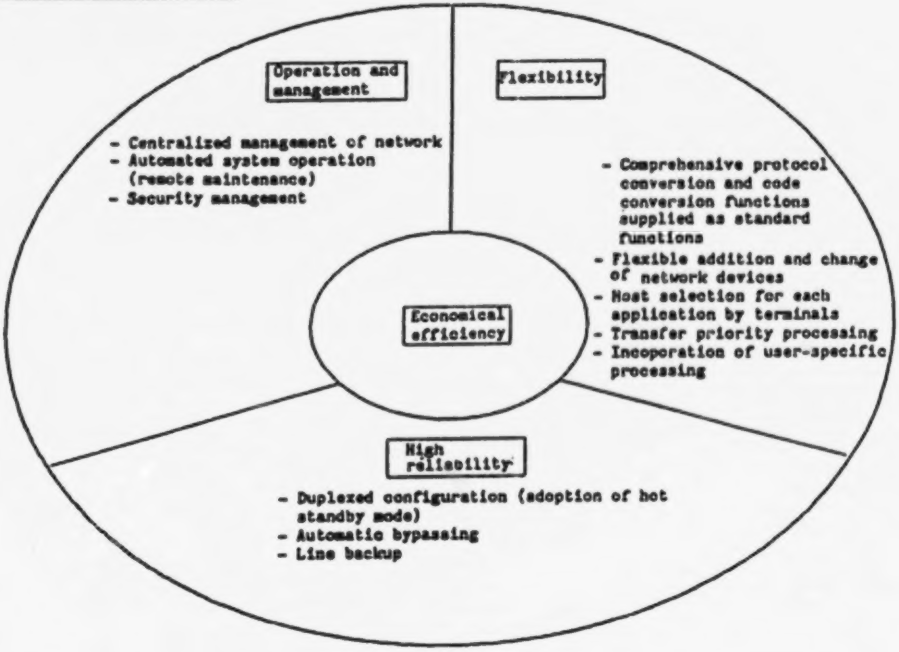

Operation and management
Flexibility
- Centralized management of network
- Automated system operation (remote maintenance)
- Security management
- Comprehensive protocol conversion and code conversion functions supplied as standard functions
- Flexible addition and change of network devices
- Host selection for each application by terminals
- Transfer priority processing
- Incoporation of user-specific processing
Economical efficiency
High reliability
- Duplexed configuration (adoption of hot standby mode)
- Automatic bypassing
- Line backup

Figure 3.1

Mesh network

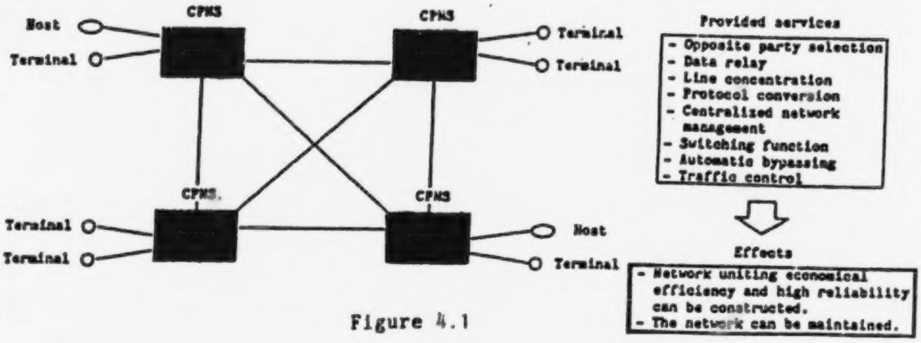

CPNS
CPNS
CPNS
CPNS
Host
Terminal
Terminal
Terminal
Terminal
Terminal
Host
Terminal
Provided services
- Opposite party selection
- Data relay
- Line concentration
- Protocol conversion
- Centralized network management
- Switching function
- Automatic bypassing
- Traffic control
Effects
- Network uniting economical efficiency and high reliability can be constructed.
- The network can be maintained.

Figure 4.1

Access point

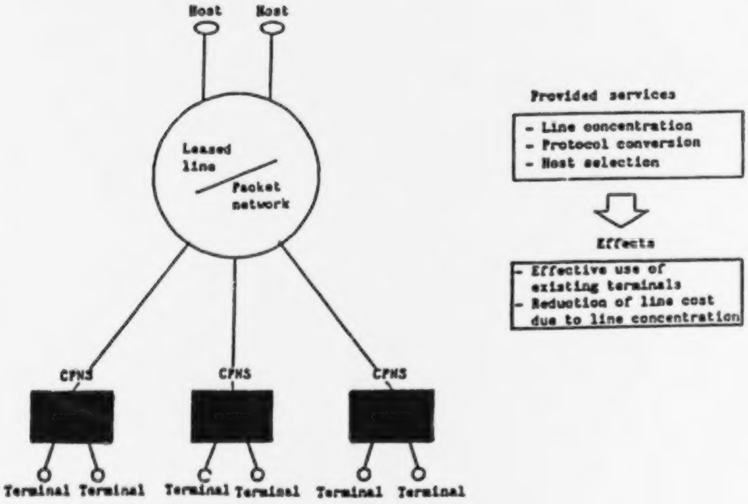
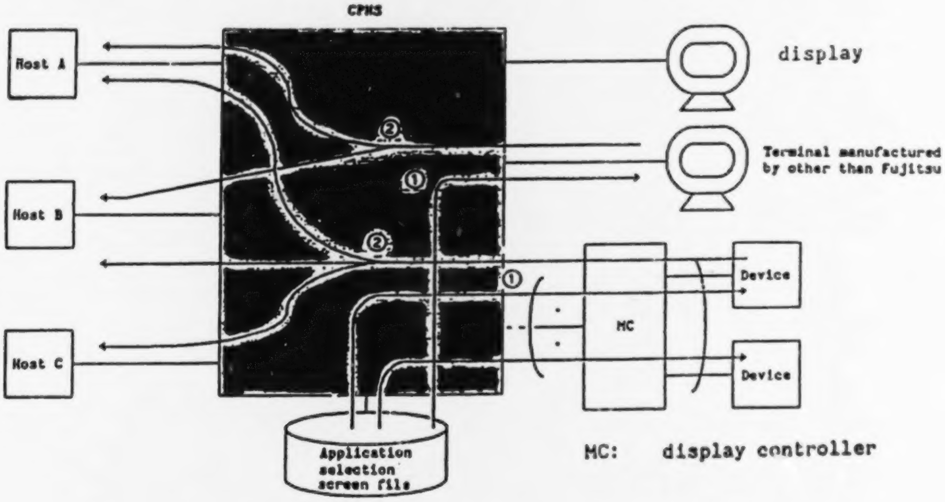

Host
Host
Leased line
Packet network
CPNS
CPNS
CPNS
Terminal
Terminal
Terminal
Terminal
Terminal
Terminal
Provided services
- Line concentration
- Protocol conversion
- Host selection
Effects
- Effective use of existing terminals
- Reduction of line cost due to line concentration

Figure 4.2

Host selection function

- A host can be selected for each application, without being concerned about hosts.


CPNS
Host A
Host B
Host C
display
Terminal manufactured by other than Fujitsu
Device
Device
MC
②
①
②
①
Application selection screen file
MC: display controller

①: The application selection screen is displayed on the device (terminal).

②: By selecting the application selection screen, CPNS can automatically select a host.

Figure 5.1

Transfer priority control

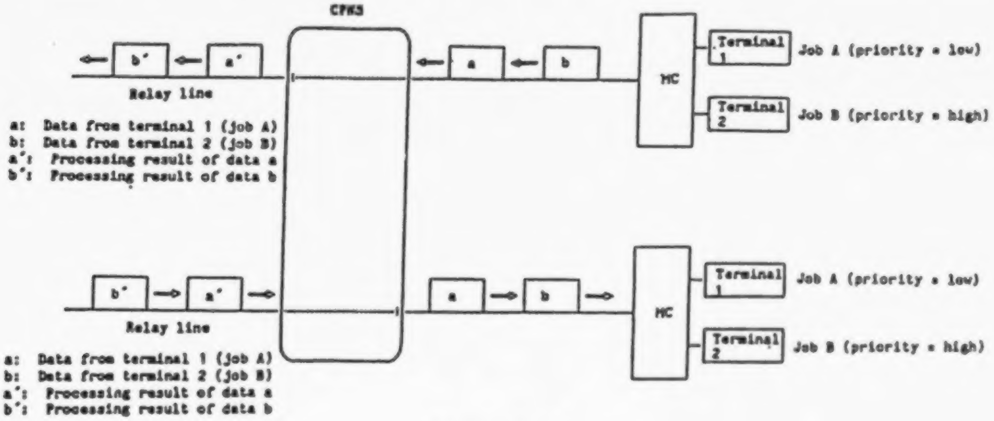
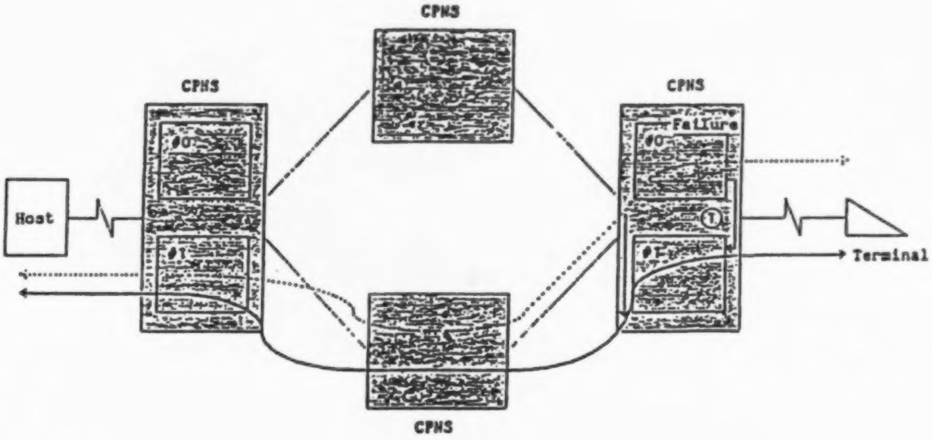

CPNS
b'
a'
a
b
Relay line
MC
Terminal 1
Terminal 2
Job A (priority = low)
Job B (priority = high)
a: Data from terminal 1 (job A)
b: Data from terminal 2 (job B)
a': Processing result of data a
b': Processing result of data b
b'
a'
a
b
Relay line
MC
Terminal 1
Terminal 2
Job A (priority = low)
Job B (priority = high)
a: Data from terminal 1 (job A)
b: Data from terminal 2 (job B)
a': Processing result of data a
b': Processing result of data b

Figure 5.2

High network reliability

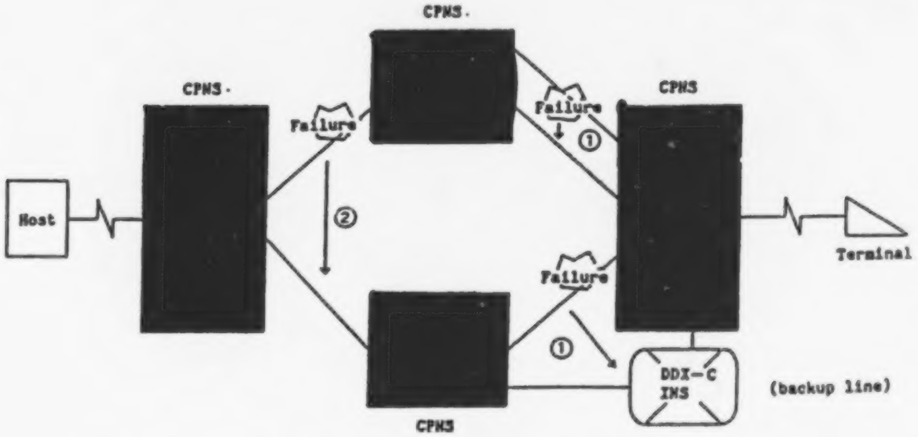
- The hardware configurastion of CPNS is duplexed so that the master system is automatically switched to the slave system if a failure occurs in the master system.


CPNS
CPNS
CPNS
CPNS
Host
#0
#1
#0
Failure
①
#1
Terminal

①: Automatic switching at failure occurrence

Figure 5.3

- If a line failure occurs in the network, the line is automatically switched to a backup line or the automatic bypassing function is performed.

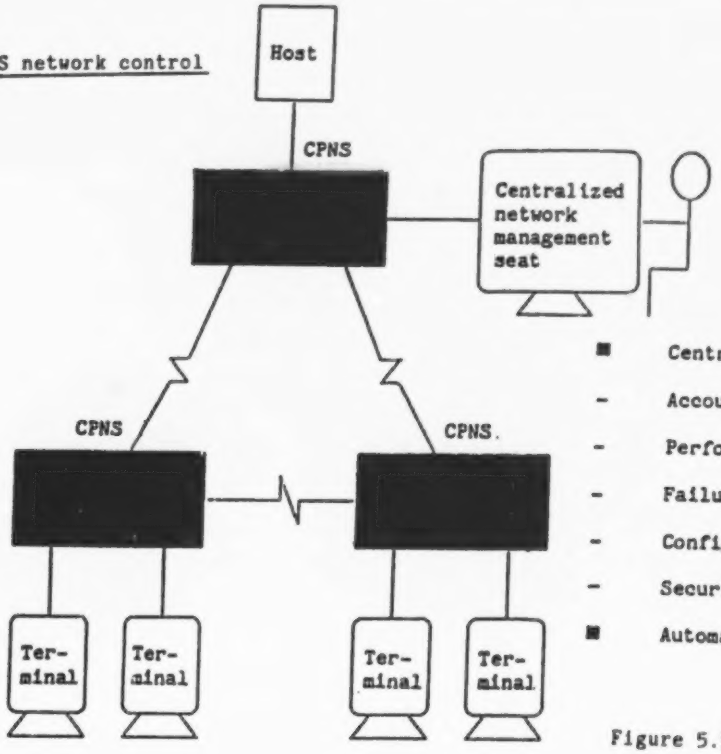

CPNS
CPNS
CPNS
CPNS
Failure
Failure
Failure
①
①
②
Host
Terminal
DDX-C
INS
(backup line)

①: Automatic switching to backup line at line failure occurrence

②: Automatic bypassing at line failure occurrence

Figure 5.4

CPNS network control


Host
CPNS
Centralized network management seat
CPNS
CPNS.
Ter-minal
Ter-minal
Ter-minal
Ter-minal

- Centralized network management
  - Accounting management
  - Performance management
  - Failure management
  - Configuration management
  - Security management
- Automated system operation for nodes

Figure 5.5

INTERCONNECTING THE PACIFIC BASIN WITH THE GLOBAL PACKET NETWORK: CHALLENGES, OPPORTUNITIES AND BENEFIT

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1. ABSTRACT

The world community stands on the verge of a new era in telecommunications technology and utilization. The people of the Pacific Basin, are, however, being bypassed by these developments. It is the purpose of this paper to suggest a model by which the Pacific Islands can begin to participate in the telecommunications revolution. To facilitate the discussion of this model this paper has been organized into the following major sections: (1) Introduction; (2) The Benefits of a Regional Digital Packet Data Network; (3) A Regional Digital Packet Data Network Model; (4) Political and Legal Implications of a Regional Digital Network in a Multi-Regulatory Trans Border Communication Environment; and (5) Some Social, Cultural, and Philosophic implications.

2. INTRODUCTION

The world community stands on the verge of a new era in telecommunications technology and utilization. Developments within these areas promise states and individuals access to information on a level undreamed of 50 years ago. Not only is more information available, but it is also more reliable. The ease and speed with which we can access, revise, and expand this information presages a knowledge explosion whose impact may be as great on our society as the knowledge explosion which created the Renaissance and the early modern world.

The potential of this revolution has been recognized by a variety of individuals and in a variety of different publications and forums, especially those sponsored by the Pacific Telecommunications Council (1). It has led the United Nations to include within the Universal Declaration on Human Rights the following statement:

"Everyone has the right to freedom of opinion and expression: this right includes the freedom to hold opinions without interference and to seek, receive and impart information and ideas through any media and regardless of frontiers."

This article, number 19, was unanimously adopted by the General Assembly on December 10, 1949, (2).

Unfortunately, the people of this Pacific Basin are being bypassed by these developments. Their remoteness, small populations, inadequate infrastructure, limited financial resources, and limited potential for economic development have all conspired to limit the telecommunications technology and systems available to them. This situation in turn has severely limited their access to information and their ability to exercise the rights described in the U.N. Declaration.

The nations of the Pacific Rim and the major international carriers have focused on establishing effective telecommunications among themselves. Thin route areas have been ignored in favor of the more profitable routes connecting the rim nations with each other and the financial, economic, and political centers of Europe, Asia, and America.

What systems there are, are costly and utilize less than state of the art technology. They are controlled by local Postal Telephone and Telegraph Adminitrations (PTT's) which are constantly faced by the dilemma of upgrading their systems and services, while providing revenue to their respective governments to maintain non-communication services and to stimulate economic development in other areas. The "non-commercial systems", such as PEACESAT, and single side band networks, such as Micronet, have tried to offset this disadvantage, but with only limited success. They have been handicapped by insufficient funds, inadequate equipment, low technology systems which cannot access the full range of information resources available, limitations placed upon their use by the political entities that they seek to serve, and an indifferent international telecommunications community.

It is the purpose of this paper to suggest an alternative that can begin to redress the balance between the Pacific Basin and the Pacific Rim within the area of information access. This alternative is based upon the creation of a Regional Packet Data Network described in Section 3 below. This network is intended to serve three major purposes. First it will provide inter-island links within the Pacific Basin to allow the Pacific Island nations to share information with each other on a more frequent basis than has been possible in the past. The Pacific Island nations share cultural traditions and developmental problems. A more efficient and effective communication system will allow for the strengthening and maintenance of common traditions and will lead to more effective solutions to common problems by providing the means to share limited technical, intellectual, and informational resources.

Second, a Regional Data Network will provide a seamless interface for island users with international data networks that have previously been unavailable to island communities and individual users. Such access will greatly expand the information resources available to the Pacific Basin. This expansion will help to develop new and more effective solutions to the problems of development within an island environment and expand the educational and individual enrichment opportunities available to Pacific Island residents.

Finally, such a Network will provide the inter-island and international linkages required by the region's developing economies. It is becoming increasingly apparent that, if a nation intends to participate in the world economy of the twenty first century, it must possess and utilize state of the art data telecommunications systems. Instantaneous and reliable data transfers have become the backbone of the world's economy. If the Pacific Basin is to continue to develop and to avoid being overrun by outside forces beyond its control, it must upgrade its present data systems and networks.

3. Benefits of a Regional Digital Packet Data Network

The establishment of a Regional Packet Data Network, that is capable of serving inter-island needs, as well as providing a seamless interface with the world data network universe, will provide a variety of benefits to the region that are not now commonly available. These benefits will initially fall into seven major areas or groupings.

While the following list is not meant to be exhaustive, it provides a useful overview of the services that a Regional Data Network can provide to governments, economic entities and individuals.

(3.1) The creation of a Regional Data Network will promote education on all levels within the Pacific Basin. Distance education offerings can be developed, utilizing computers, which combine the network's electronic mail, conferencing, and bulletin board capabilities. Such a combination will allow for both student-teacher and student-student interaction on a real time basis. Papers, quizzes, and discussion can be routed through these systems. These courses will run the gamete from traditional course offerings to tutorials. They will be especially useful in small population areas because of their adaptability to multi-site offerings. Such offerings are a necessity for the Pacific Basin, where gathering students in one central location is cost prohibitive.

In addition to course offerings a Regional Data Network interfacing with international networks will facilitate research, teacher-teacher interchange, and student-student interchange outside of the classroom. The latter may be of special interest at the late primary and middle school levels where students can interact with students from other islands and cultures on an informal or semi-formal basis through electronic mail and bulletin boards. "Computer clubs" of this nature will not only broaden a student's intellectual horizons, but will help to teach and reinforce computer, information processing and language skills.

Once established the network will allow regional department's or ministry's of education to expand their offerings and resources far beyond what they are able to develop on their own. These activities will be useful not only for formal educational experiences, but will lend themselves to informal/extension experiences as well.

(3.2) The Network will provide full conferencing and bulletin board capabilities to governments, businesses, groups, and individuals throughout the Pacific. These capabilities will allow the broadcast and revision of information to interested parties around the world on a variety of topics. The implications of these capabilities for problem solving within a resource poor area such as the Pacific Basin are immense.

(3.3) A Regional Data Network will facilitate medical consultation between medical personnel in population centers and remote islands. Several medical journals and newsletters are presently online. Access to these resources will aid medical personnel in remote areas to keep current in their various disciplines.

(3.4) The economic benefits of such a network are legion. The following is a partial list of examples and should by no means be considered exhaustive.

(3.4.1) The Movement of funds by on line computers.

(3.4.2) Credit card verification.

(3.4.3) The purchase and sale of stocks, bonds, and commodities. In addition the network would allow local brokers to research companies for their clients.

(3.4.4) Insurance policy sales and claims processing.

(3.4.5) Credit references.

(3.4.6) Procurement and sales for companies within the region operating on a regional basis.

(3.4.7) The booking of reservations for travel and lodgings by the region's tourism companies.

(3.4.8) Same day purchasing and payment by electronic data interchange and fund transfers.

(3.5) The Network will provide electronic mail services throughout the world for governments, businesses, civic groups, and individuals. These services will be particularly important for agencies and enterprises whose executives and employees must engage in significant periods of off island travel. With an effective electronic mail system, their services will no longer be lost to their agencies or enterprises while traveling.

These services will also help families to keep in touch with their members who are traveling, working, or living in other parts of the world. Family cohesiveness is one of the positive aspects of Pacific Island cultures. An efficient and cost effective electronic mail system will help to decrease the tensions that the scattering of family members over wide distances, due to economic and social necessities, has placed upon the unity and integrity of the extended family.

(3.6) The regional network will aid island governments in communicating with each other on a cost effective basis. On going discussions of common issues and problems will be possible on a day to day basis, rather than the longer time frames now dictated by mail services, and cost prohibitive telecommunications systems.

(3.7) The Network will provide access to international and regional data bases. These services are especially important to professionals, researchers, governments, universities, and businesses. Once the Network is in operation and information on the region is sought and used both locally and internationally, it is expected that existing regional data bases will be expanded and new data bases created to better serve the regions needs.(3)

4. A Regional Digital Packet Data Network Model

4.1 General Network Overview

The need for a Pacific Regional Network stems from the requirements of island users to interconnect data terminal equipment with the ease and economy enjoyed by users in developed countries. This Network will provide Pacific Basin users with a verity of data network applications; such as timesharing, file transfer, financial management, message processing, and credit verification. It will provide efficient regional data communications, direct gateways to major United States Value Added Networks (VAN's) and reliable, cost effective data communications to virtually any country in the world.

Throughout the developed countries, each VAN defines its own access procedures and protocols. It is proposed that a Pacific Regional Network be a seamless interface with each major VAN in the United States and other countries as needed. A Seamless interface would mean that a user of Tymnet, Telenet, Compuserve Network Services or MARK*NET would have the same access procedures in the Pacific Basin as they would have within the United States. Network users would be able to use the same Usernames and accounts on any island in the region or even throughout the world. Any subscriber of the public international VAN's would be able to use the Pacific regional Network in the same manner and his billing arrangements would remain the responsibility of the servicing VAN. In the Pacific region users of public services and data bases would access the service utilizing procedures identical to those used in the domestic United States.

Because of the low density of traffic and the limited number of users within the Pacific, it is difficult to achieve an economy of scale, if separate networks are established for each VAN. In order to provide cost effective data communications for all users within the region, the Pacific regional network must provide Seamless access to each major VAN as well as support the efficient and economical handling of all intra Pacific data Traffic.

The Pacific regional network will use packet switching technology. A reliable and economic network can be designed by creating a series of backbone nodes interconnected by high speed links capable of transmitting packets of user data through virtual circuits sharing common physical links. The backbone nodes will have multiple redundant links including satellite and fiber optic connectivity. If a link in the transmission route fails, the packets will automatically and transparently be rerouted over an alternate path.

Each node will provide error correction and detection between itself and its neighbor nodes. Since a packet network is not dependent on end to end (modem to modem) error correction, a higher throughput of error free communications is maintained. Additional error correction is provided on the local loops using Microcom Networking Protocol (MNP) or X.PC error correction.

Because of the shared use of the communications infrastructure, a packet network is more cost effective then traditional leased line facilities for sending data between regional points or to other packet networks. It is effective for users between multiple destinations as well as interactive terminal sessions.

3.2 Access Methods

Each Island that has a Node of the regional network will have public dial-up service. This dial-up service will be divided between the connectivity with the major Global and International VAN's (Tymnet and Telenet) and intraregional data communication service. Public dial-up access will allow reverse charge usage (billing to called host) as well as prepaid service paid for by the local user. Dial-up users will generally connect to network hosts or to outdial modems. Outdial modems will be used for hosts not accessible through the Regional Network or it's gateways.

High volume users will have the option to use private dial-up ports. This service will allow exclusive use of a dial-up port on a continuous basis for a monthly flat rate charge. Private Dial-up ports will be available at 1200 or 2400 Baud Asynchronously or 2400, 4800 or 9600 Baud Synchronously.

Dedicated access network connections will be provided for both sychronous and asychronous applications. Speeds available will range from 1200 Baud to 19.2 Kilobaud. Dedicated connections may be a single port of the network, a Packet Assembler/Disassembler or a Terminal Concentrator for multiple port requirements.

Multiple protocol users will find Customer Premises Equipment an efficient solution. This will place a customer owned or leased network node directly on the customer premises.

The network will provide the capability and support for multiple protocols common in the user market. These include asyncronous interfaces, X.25 interfaces, SDLC/HDLC/QLLC Interfaces, 3270 Bisync, 3270 SNA, HASP and Local Area Network Gateways. In addition to end to end support of protocols, protocol conversion is commonly required.

3.2 Network Management

The Pacific Regional Network should have a centralized management for monitoring and control, validations, and accounting. A centralized management will allow for better coordination of trouble resolution both at the field site and with other network providers. A single entity responsible for traffic accounting, settlement accounting with other networks and the billing of direct customers will provide an economy of scale beyond that which could be achieved, if each political entity attempted to duplicate these facilities and resources.

The centralized network management would be responsible for the following: Continuous Real Time Network Monitoring; Trouble Ticket Processing; Assistance of Field Support personal; Enforcing Escalations; code generation and management; Tracking and Verification of Problem Resolution; and interfacing with other Network Control Centers.

Having a centralized staff of trained network support personal located in the Pacific will enhance customer support during the region's normal business hours. In addition firstline support of local customers will be provided by local Pacific Islander's dedicated to network support.

Consolidating the data traffic between the Pacific regional network and the International VAN's will reduce the costs of gateways and assure the best possible rate to user. The regional network will offer both traffic sensitive and flat rate services for interconnections between the islands as well as to the VAN's. A sample rate schedule is contained in Figure 1.

Figure 1.

Representative Rate Schedule *

	Intra-Pacific Region	PacificUS	Pacific Rest of World
Hourly Public Dial	**$10.20 - $14.00**	**$12.00 - $14.00**	**$18.00 - $24.00**
*9.6 Dedicated interface Monthly ***	**$2,050 - $2,650**	**$2,500 - $3,600**	**$3,600 - $4,500**

*** Based on current Tymnet, Telenet and PacNet Transborder Data Rates**
**** Does not include termination (typical termination interface $1,500 -$2,000 per month)**

5. Political and Legal Implications of a Regional Digital Network in a Multi-Regulatory Transborder Communication Environment

For decades a variety of individuals have touted a vision of a Pacific economic community, binding that enormous region together in a way that would approximate the European Economic Community. The idea has had to overcome the vast economic, political, social and cultural diversity of the nations of the Pacific Rim, which stretches in a vast arc from Mexico, Canada and the United States in the Western Hemisphere to Japan, China, Southeast Asia and Australia in the Eastern. Pulling together these disparate parts is obviously a far harder task than creating a Common Market in Europe, a process which has been underway for over 30 years.

An important step in that effort occurred late last year in Canberra with the first meeting of the Asian Pacific Economic Cooperation ("APEC"), with representatives of Canada, Japan, South Korea, New Zealand, the United States, and the six members of ASEAN - Brunei, Indonesia, Malaysia, the Philippines, Singapore and Thailand. Conceived by Australian Prime Minister Hawke and supported by U.S. Secretary of State Baker as "idea whose time has come", the meeting of APEC nations set as its ambitious objective the launching of a new Pacific economic grouping similar to the European-based Organization for Economic Cooperation and Development. (4)

Although participants fell short of this goal and little substance emerged from the first APEC meeting, the parties did issue a communique agreeing on the need to develop new regional data bases and to explore ways of improving the flow of information and technology among the Pacific nations.

The early emergence of telecommunication as a priority of the Pacific nations is, of course, not surprising given the geographic breadth and diversity that divides them. It is therefore worth speculating about what legal and regulatory barriers may lie in store for the nations of the Pacific in realizing their dream of a seamless telecommunications network, and whether the agenda set in the Green Paper of the European Community offers any useful example. (5)

On the regulatory side, as might be expected, there is much diversity among the Pacific nations. In the United States the Federal Communications Commission has done much over the past decade to increase open entry in the provision of international communications. In recent years the Commission has moved to apply its dominant/non-dominant carrier classification to the provision of international telecommunications services to and from the United States: (6) authorized the construction and launch of private satellite systems; (7) permitted the landing and operation of private carrier trans-oceanic cable systems; (8) extended Computer II and III into the international arena: (9) enabled US enhanced service providers who offer an international "public correspondence" service under ITU Conventions to obtain designation as Recognized Private Operating Agencies and Indefeasible Rights of Use in overseas common carrier submarine cable facilities (10) and eliminated the voice/record dichotomy to allow any US carrier to provide virtually any kind of service to international points form any where in the United States. (11).

Other nations of the Pacific Rim and Pacific Basin, however, have not followed the Commission's lead. There remains a great diversity in the telecommunication systems in the countries of the region, ranging from the sophisticated and extensive infrastructure of Japan to the more rudimentary systems of the Philippines, Indonesia, and the Pacific Basin. The regulatory regimes of the countries also differ widely, with many governments looking for the right formula for government control and privatization to ensure a modern telecommunications infrastructure. In spite of accelerating economic growth. The funding of communications expansion programs has been a growing headache for many Pacific governments. With few exceptions, many Pacific nations have fallen behind with telecommunication development plans because of funding problems. Although multilateral lending agencies have been active in Asia for many years, their role in financing telecommunications development has been limited compared with other sectors such as agriculture and energy.

Against this background, the analogy of the Green Paper is an appealing one since the problems of the European community and of the Pacific Basin have many similarities.

To be sure, there are significant cultural, economic and political differences between the two regions, and one must embark on any analogy with a great deal of caution. Nevertheless, with the experience of the European Community unfolding before us, it is worthwhile to see what lessons from it may be learned.

As the authors of the Green Paper have observed, information,and exchanges of knowledge and communications are of vital importance to the economic activity and balance of power in the world today. New technologies and telecommunications services have played central roles in breaking down traditional political and geographic barriers and have presented an unprecedented opportunity for greater regional economic development. To flourish, however, such technologies and services must exist in a climate of cooperation among regional governments, with a common consensus encouraging open and dynamic competition. In short, national frontiers should not be allowed to hamper the development of an integrated communications system within a region, be it the European Community or the nations of the Pacific.

As the Green Paper authors correctly observed, the traditional form of organization for the telecommunications sector -- the Telecommunications Administration -- is generally incapable of promoting a cooperative and competitive framework vital to the emergence of trans-border telecommunications service. Therefor, more creative approaches must be explored. The convergence of telecommunications, data-processing and the audio-visual sectors; the rapid rate of technological diversification (e.g. signal digitalization, optical cables, computer networks, cellular telephones, satellites); the expanding range of new forms of access to sources of information (television, data bases and banks, knowledge banks, etc.); the explosive growth in communications requirements (financial and commercial transactions, research networks, international tourism, cultural exchanges, worldwide interdependence, etc.); and the major importance of scale effects through multinational participation have all blurred traditional political and regulatory boundaries and forced nations to rethink the issue of how to promote an environment which provides users with a greater variety of telecommunication services, of better quality and at lower costs

While Telecommunications Administrations have an important role to play in such a project, it is clear that the full potential of telecommunications services can only develop in a large, unobstructed market. This in turn requires an ambitious regulatory/legal agenda, which the Green Paper sets forth in detail. By focusing on the creation of a liberalized, unconstricted and integrated telecommunications infrastructure. When the agenda calls for, inter alia, the development of uniform technical standards and specifications supporting compatibility and interoperability of systems. The acceptance by Telecommunications Administration of the obligation to provide interconnection and access to trans-border service providers is the ultimate separation of the regulatory and operational functions of the Administrations. They also must encourage and provide for the development of regional, harmonized tariff principles; and the development of consensus on legal issues pertaining to data protection, copyright protection, electronic fraud, and the protection of confidentiality of content of users' communications.

Such ambitious goals, which the European community has set for itself, are of obvious relevance to the nations of the Pacific region. If the European experience is relevant, the road to achieving such goals will be difficult, and marked by varying degrees of resistance. Hopefully, the common purpose set by the members of APEC will enable the nations of the Pacific region to avoid many of the pitfalls encountered by the European community, and bring the dream of a seamless Pacific regional telecommunications network closer to fruition.

6. Some Social, Cultural, and Philosophic Implications

While the establishment of a Regional Data Network will have many political economic, social, and educational effects (see section 4), it will also affect the region's traditional social/cultural institutions. whether this impact will be positive or negative depends upon the Pacific Islander's ability to successfully incorporate this technology and the access to information that it implies into their social and cultural systems.

While it may have been arguable in the past that a society could choose not to develop, it no longer appears that this is the case. Development will occur, whether a nation or people wishes it or not. Societies and cultures will change and these changes will be mandated by forces and processes that are only partially controlled by the peoples being directly effected.

The history of the Pacific since World War Two provides many examples of the validity of this assertion. Today, even the remotest atoll has been touched and changed by modern communications, transportation and economic systems, and technology. These changes have been particularly profound in the areas of education and access to information. Traditionally, Pacific Island cultures have viewed information and skills as being the "personal possessions" of clans/lineages. To a certain extent traditional systems of authority have been based upon and reinforced by their elites ' ability to control access to information and to limit its dissemination within their social systems.

The establishment of a Regional Data Network, which provides free access to information to all citizens, cannot help but change these traditional relationships. For the negative aspects of this change to be minimized carriers, providers, users, and governments will have to work together to develop a flexible system of responses that will allow change to take place without the total disruption of the social fabric.

7. Summary

Well defined reasons exist for the liberalization and deregulation of data communications. The creation of a seamless Regional Data Network that eliminates transboarder data communications barriers between Pacific countries should be encouraged. The Pacific Region covers over one third of the earth's surface. Affordable and accessible communications will enhance education, medical services as well as encourage regional development. In addition, the easing of telecommunications restrictions will permit regional business's to operate more effectively throughout the Pacific as well as improve business links with Asia and the Western Hemisphere.

8. Footnotes

(1) For examples see the following articles: Sir Thomas R.A.H. Davis,"Communication and Developing Countries in the Pacific, in Telecom Pacific (Honolulu:PTC,1983), edited by S.A. Rahim and D.J. Wedemeyer, p.p. 127-131; Meheroo Jussawalla, "Socioeconomic Policy Issues of New Telecommunications Technology," in Telecom Pacific (Honolulu: PTC,1983, edited by S.A. Rahim and D.J. Wedemeyer, p.p. 111-119; and L. Mukaida, G. Knezek, P. Scannell, G. Jones, T. Avegalio, A. Freese, and J. Haak, "Pacific Island Interactive Data Base Network Access: a PeaceSat, Pichtr, University of Hawaii Library Pilot Project, in Proceedings: PTC, 89 (Honolulu: PTC,1989), edited by L. S.. Harms and D.J. Wedemeyer, p.p. 494-501

(2) Quoted and discussed in L.S. Harms, "Communication in Society: a Long-range Goal," in. Telecom Pacific (Honolulu: PTC,1983), edited by S. A. Rahim and D. J. Wedemeyer pp. 25-29. " Telecommunications for Pacific Development: PTC '85, edited by D.J. Wedemeyer, p.p. 130-135 and 354-355 respectively.

(3) For further discussion on the functioning and applications of data networks see G.A. Knezek, P. Scannell and J. M. Flannigan, "Personal Computer-Based Communication Systems" and E J. Wilkinson, "System and Hardware Options for Digital Telecommunications Networks in the South Pacific", in Telecommunications for the Pacific Development: PTC '85, edited by D.J. Wedemeyer, p.p. 130-135 and 354-355 respectively

(4) Washington Post, August 16, 1989 ("The Pacific Economic Compact: Bob Hawke's Plan to Move It Closer to Reality"), November 7, 1989 ("Pacific Rim Nations Tentative on Talks Over Trade Group Differences Center on Scope of Organization"), and November 8, 1989 ("Pacific Rim Meeting Called Step Forward"); Business Week, November 20, 1989 ("Pacific Overtures").

(5) Commission of the European Communities, "Towards a Dynamic European Economy: Green Paper on the Development of the Common Market for Telecommunications Services and Equipment", Brussels, June 30, 1987.

(6) International Competitive Carrier Policies, 102 FCC 2d 812 (1985), recons. denied, 60 Rad. Reg. 2d (P&F) 1435 (1986).

(7) Establishment of Satellite Systems Providing International Communications, 101 FCC 2 d 1046 (1985), recons. denied, 1 FCC Rcd 439 (1986).

(8) Tel-Optik, Limited, 100 FCC 2d 1033 (1985).

(9) Amendment to Sections 64.702 of the Commission's Rules and Regulations (Third Computer Inquiry), 2 FCC Rcd 3072 (1987).

(10) International Communications Policies Governing Designation of Recognized Private Operating Agencies, Grants of IRUs in International Facilities and Assignment of Data Network Identification Codes, 104 FCC 2d 208 (1986), modified, 2 FCC Rcd 7375 (1987).

(11) Inquiry into Policy to be Followed in Future Authorization of Overseas Service, 36 FCC 2d 605 (1972) (Notice of Inquiry), 57 FCC 2d 705 (1976) (Report and Order), reviewed sub nom. ITT World Communications, Inc. V. FCC, 555 F.2d 1125 (2d Cir. 1977), policy Applied, AT&T and Co., 75 FCC 2d 682 (1980), aff'd sub nom. Western Union International, Inc v. FCC, 673 F.2d 539 (D.C.Cir. 1982). Western Union International, Inc., 76 FCC 2d 166, aff'd sub nom. Western Union International, Inc. v. FCC, 673 F.2d 539 (D.C. Cir. 1982).

Compressed Voices, Expanded Networks

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ABSTRACT

The interexchange cost of sophisticated digital phone links has declined dramatically worldwide. In the US domestic market, introduction of Fractional T1 services by major carriers has brought the cost of a 56-kbps DS0 circuit to near parity with voice-grade analog private lines. This paper examines the impact of these economic changes on *voice* communications, still the dominant feature of business telecommunications expense, and discusses hardware required to take advantage of these new services to reduce private-line voice and data communications costs. Two examples are examined in some detail and essential features of an optimal voice/data multiplexer are presented.

In the US domestic market and throughout the world, the cost of leasing 64 kbps digital circuits is falling dramatically. When compared with voice grade private line rates, digital tariffs have plummeted during 1989 at an unprecedented rate. The trend was started earlier this year when AT&T startled the industry by cutting its 64 kbps rate by as much as 75 percent in one amazing stroke. Although local access charges present a more complicated picture, signs of downward movement in that segment of the national network are also becoming clear.

As recently as two years ago the cost of voice grade private line interconnection was anywhere from 50 to 80 percent less expensive than an equivalent 64 kbps line. Today, however, the interexchange piece of that same digital circuit now costs less than a voice grade private line covering the same distance. Even when the more expensive local exchange pieces are added, the cost of digital 64 kbps and analog circuits are comparable in most cases.

Last April, in announcing the introduction of its *ACCUNET Spectrum of Digital Services* (ASDS), now referred to as the Fractional T1 offering, AT&T drew a fascinating comparison. Reproduced here in Table 1, that comparison shows relative pricing for four separate interexchange services as a function of mileage.

As shown in the table, the rate for ASDS service is held constant at $1.00, and represents the relative cost of leasing a single DS0 (64 kbps) channel from AT&T. The second column, marked "VGPL," shows the relative cost of leasing an AT&T voice grade private line of the same distance. The third column gives the cost of 56 kbps DDS service from AT&T. Although DDS service is delivered over a separate network from the ASDS offering, the difference in performance specifications between

Table 1:
ACCUNET® Spectrum of Digital Services
Pricing Schedule and Pricing Comparisons

Miles Between Sites	***ASDS***	VGPL	DDS (56 kbps)	T1.5
25	$1.00	$1.01	$3.57	$0.53
100	$1.00	$1.01	$3.52	$0.42
200	$1.00	$1.06	$4.04	$0.53
300	$1.00	$1.11	$4.47	$0.61
400	$1.00	$1.15	$4.83	$0.69
500	$1.00	$1.18	$5.14	$0.75
600	$1.00	$1.17	$5.13	$0.81
700	$1.00	$1.16	$5.13	$0.86
800	$1.00	$1.15	$5.12	$0.90
900	$1.00	$1.14	$5.12	$0.94
1000	$1.00	$1.13	$5.12	$0.97
1100	$1.00	$1.12	$5.11	$1.00
1200	$1.00	$1.11	$5.11	$1.03

USING THIS TABLE: For every dollar a customer spends for an ASDS DS0, the three columns to the right show how many dollars the customer must spend for a single voice-grade private line (VGPL) circuit, a 56 -kbps DDS circuit, and a single DS0 channel of a T1.5 circuit.

For example, at 300 miles, if an *ASDS* DS0 is $1.00, a VGPL IOC is $1.11, the DDS line is $4.47, and a single DS0 of a T1 line is $0.61.

the two services is small enough that the price difference will make ASDS irresistible to many users. Finally, the column marked "T1.5" shows the equivalent cost of a DS0 delivered to a customer who has leased a full T1 (1.544 megabits per second) line from AT&T and divided it using his own terminal equipment into 24 DS0's.

As this is written, relative prices for DS0 service from other carriers such as US Sprint and MCI are either comparable to or lower than AT&T's in most cases. Indeed US Sprint, by introducing its "Virtual Private Network" fractional T1 (FT1) service at all of its US points-of-presence (POP's), holds a distinct if temporary market advantage; access to AT&T's FT1 service is being phased in gradually, and this will doubtless provide for limited availability at the AT&T POP's for some time to come.

From the data in Table 1, two obvious conclusions may be drawn: Voice grade private lines are priced at parity with DS0 service, and DDS offerings are at a tremendous market disadvantage to the new Fractional T1 services.

Faced with this inversion of rates, how does a network manager best exploit the economic opportunity they represent? Certainly additional data-oriented applications, perhaps not previously feasible due to high transmission rates, may now deserve a second look. Using relatively high-speed bridges to interconnect LAN's, for example, becomes a straightforward and relatively inexpensive process. Tying CAD or CAE workstations between remote locations and central computers is another promising application.

But from a larger perspective, most telecommunication managers will tell you that it is not the pure data applications, but rather the aggregate of voice communication, image transmission (fax) and analog modulated data which consume by far the biggest wedge of the communications budget pie. In a recent private survey of several financial services organizations, it was found that between 65 and 80 percent of the annual communications services budget was devoted to these "voice" services. The balance was divided among the multiple data applications so vital to the organizations' day-to-day business.

So, while new and exciting opportunities in data applications do exist and will continue emerging, it is the dominant position of voice transmission in business communications that suggests the best utilization of these new, inexpensive DS0 lines. There is a catch, however – and a big one at that.

Carrying voice signals on a digital circuit naturally requires that the voice be encoded in digital form. The traditional technique for doing this requires a digital bandwidth of 64 kbps (the entire DS0 channel) to represent a single conversation. Clearly, at a cost of one DS0 per voice channel there is no economic advantage in using a DS0 versus a voice grade private line. More efficient techniques now exist, however, which can reduce the digital rate needed to represent a voice call. With less bandwidth required, the user can use each DS0 to carry multiple voice calls simultaneously with potential for saving many times the equivalent voice grade private line cost as a result. The key question that a user must ask and answer for himself is this: What characteristics are required of a compressed and digitized voice channel? The answers are not so obvious or easy to answer.

Compressed Voice Line Criteria

To begin answering the question just posed, the most obvious, and for most users the most important consideration is the *subjective perceived quality* of the voice signal itself, after it has been transmitted through the compressed, digitized link. No obvious impairments can be introduced lest users feel that their primary tool for business, their telephone service, has been degraded. Thus, the digital processing technique must be capable of reproducing any speaker's voice with at least the same fidelity a user would expect of a normal telephone call; the kinds of annoying artifacts that gave a well-earned bad name to some earlier attempts at this technology are categorically unacceptable. Other impairments take the form of very long delay or echoes. It is therefore important that the voice compression technique be coupled with outstanding echo cancellation and also have minimal delay (minimal in this case means values in the tens of milliseconds as opposed to hundreds).

Before addressing the second consideration, we must first state an obvious fact about the way people use telephone lines. They do not always use them for simple conversations. That is, a voice grade line is often not used simply for voice. For example, the user may send dual tone multi-frequency (DTMF) signals over the line, either for signalling to a PBX or voice mail system, or in conjunction with voice response terminals such as those becoming popular in the banking industry. Moreover, voice lines are often used for data signals transmitted in the form of modulated analog waveforms.

One might argue that the need for analog modems could simply be eliminated by digitizing the data stream and tying it directly to the system. But since these calls often originate at points distant from direct access to the digital service, that easy answer is seldom practical. For example, a corporation may issue laptop computers with integrated V22bis modems to its salesmen in the field who will dial in over the public switched network, and then connect into the corporate digital network. Similarly, users may connect fax machines to their dial interfaces, either at their desks or in their homes, and expect for the fax signals to be reliably transported whether the medium is analog or digital. Thus, another key requirement for compressed digitized voice is that the resulting channel be *transparent* to analog modems and other non-voice signals.

A third related issue is *tandem operation* in a corporate network. By this we mean that many conversations are carried out not between a hub location and a remote location, but rather between two remote locations interconnected by one or more nodal switches in a network. Thus, the voice digitizing scheme must be able to tolerate the multiple encodings and decodings accompanying a tandem switched situation. To achieve this, the compression technique must be of extremely high quality; that is, it must exhibit low delay, excellent echo cancellation capability, and good performance under widely varying signal levels.

Finally, and certainly not the least important of the points, is that the voice digitizing equipment must be *economically sensible,* both at the outset and in the longer term. That is, the concomitant transmission-cost savings must yield an amount sufficient to pay back the investment and still furnish healthy month-to-month returns. In addition, since the technology of voice compression is still advancing and evolving, the equipment should be designed to forestall premature technical obsolescence. A technique prevalent in satellite communications for VSAT's and other types of private networking gear is the downloading of new operating software through the same transmission lines which carry the user data and voice. This method is equally applicable to voice compression equipment. The economics become even more compelling if the equipment allows simultaneous use of the digital circuits for both voice compression and data multiplexing. So, to make best use of the advanced transmission facilities, the data multiplexing capabilities of the selected equipment must be extremely flexible and, preferably, should be remotely configurable.

In fact, none of the four objectives outlined above (high perceived quality, both voice and non-voice capability, tandem operation, and economic feasibility) need present any practical impediment to the communications manager anxious to take advantage of the potential presented by low-cost DS0 service for voice communications. Products are readily available today which make voice compression and voice/data multiplexing both practical and desirable.

At this point, it may be worth exploring what developments over the past few years have moved the technology of voice compression from the merely theoretical to the eminently sensible. The advances can be classified in two areas: first in the mathematical research which has led to new families of voice compression schemes capable of producing excellent voice quality with limited bit rates; and second in the silicon technology which has produced extremely high performance digital signal processing microcomputers (DSP's), large-scale application-specific integrated circuits (ASIC's), and very high quality and inexpensive analog-to-digital (ADC) and digital-to-analog (DAC) converters. The convergence of these two areas with the economic revolution in digital transmission is providing the motive power to propel specialized voice and data multiplexers from the realm of niche markets to the forefront of data and voice applications.

New Voice Compression Technology

Among the new voice compression schemes discovered and developed in the last 10 years, one in particular is especially well suited to the corporate communication needs which we outlined above. Adaptive transform coding (ATC) is a so-called frequency-domain hybrid coding scheme. The difference between ATC and most other voice compression schemes is the initial digital signal processing operation performed on the analog voice waveform. After sampling and initial digitizing, the voice signal is transformed from the time domain to the frequency domain. It is in the frequency domain that the algorithm makes its choices in assigning the precious transmission bits to the various spectral components. This approach makes it possible, for example, to concentrate all of the digital transmission rate on a confined set of audio frequencies representing analog modem signals, such as those generated in V22bis and V.26 modems. For this reason, the ATC schemes provide excellent transparency to modem and fax signals. At our laboratories and in applications around the world, we have verified that 2400 bps fax and full-duplex PC modem applications can be reliably run over ATC-compressed voice lines with a digital data rate of 13 kbps or greater.

The ATC schemes provide excellent voice quality at relatively low delays (nominally 45 milliseconds) and exhibit very good tolerance of a wide dynamic range of signal levels. Since the scheme moves the emphasis from low to high frequencies very easily, it is especially good at representing higher pitched speakers such as young children and women, as opposed to some earlier schemes which were good for lower pitched voices, but relatively poor for many women speakers.

A major engineering breakthrough has been achieved over the past two to three years with the reduction of this complex mathematical algorithm to a form adaptable for use in relatively inexpensive circuitry. The result has been that a number of laboratories and manufacturing firms have pursued ATC for voice compression, among them AT&T, GTE, and Pacific Communication Sciences (PCSI). In a recent submission to the TIA committee on digital cellular transmission, PCSI noted that its ATC algorithm, together with forward error correction coding, required less than four mega instructions per second (mips) of processing power on a fixed-point DSP. This means that with current generation devices, the ATC algorithm can be reduced to single DSP implementations with no special input or output hardware (e.g., specialized telephones) required.

In the area of new silicon technology, the advance of the state of the art in digital signal processors is by far the most important element in the feasibility of voice compression. With companies such as Texas Instruments, Motorola, and AT&T taking the lead, both floating-point and fixed-point processors are available on a single chip which can process between 10 and 20 mega instructions per second. The companies have announced plans to introduce new processors with rates between 20 and 40 mips in the next two to three years. At these processing rates, it will be possible to handle multiple channels on a single IC or to combine multiple functions with voice compression.

Other silicon technologies which are extremely important for the integration and production of low cost voice compression and voice/data multiplexers are ASIC and ADC/DAC technology. It is now possible to design ASIC's with PC's and to program gate arrays literally at one's desk. ADC and DAC technology have advanced to the point where very high speed 12- and 16-bit resolution devices are easily available and quite inexpensive. One can thank the incredible popularity of compact disc players for the advances in DAC technology, and the long-term success of telephone line modems for the ADC technology. Interestingly, however, in voice technology only the lowly PCM coder is really required to handle many applications. The reason for this is that often voice is delivered to the voice compression unit through a public or private network utilizing PCM transmission. So, using a PCM codec for ADC and DAC functions neither adds to nor subtracts from the voice quality perceived by the end user. PCM codec technology is extremely low cost now, with single chip implementations costing less than $3 in higher quantities.

From a marketing standpoint, several feature sets are required in the basic technology of voice/data multiplexing to make the equipment practical enough and flexible enough for use in the network. These include flexibility in handling different types and rates of data, both asynchronous and synchronous, at rates as low as 75 bits per second, up to the full 56- or 64-kbps rate of the digital lines. A multiplicity of clocking modes are also required to allow different media (such as DDS, ASDS, satellite networks, and modem tail circuits) to be tied together through one multiplexer. An array of internal diagnostics, preferably remotely controlled, and overall network management systems are also necessary to provide the manager with ready access to all points in his or her network; the ability to integrate the network management into other systems already in use is also very important. As mentioned earlier, provision for downloading the operating software is critical to the longevity of the equipment. Finally, any delay introduced by the voice/data multiplexers must be extremely low, and not just for the voice-quality implications; as is well known, response time in interactive data circuits is a very strong function of the transmission delay incurred through each remote device.

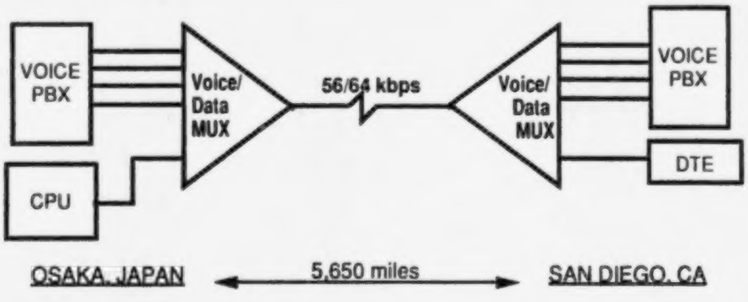
Voice/Data Mux Applications

In considering applications of this new technology, one must ask several general questions. First, what economic savings can be realized from installation of compressed voice and data multiplexers? Second, what compromises in voice quality is one willing to accept to achieve a certain level of cost savings? Our research tells us that with current state-of-the-art technology, coding rates in the range of 11 to 16 kbps can deliver voice quality so high that most corporate users will not readily perceive differences from standard PCM. At bottom, however, the answer to this question implies a business decision which rests on a price/performance ratio which can only be determined from financial analysis of each individual situation. In the following sections, economic analyses are presented for two different applications of voice compression and multiplexing.

International Tie-Line Replacement

Not long ago, a private overseas telephone link would have been an extravagance affordable by few private firms. Today, the growth of multinational corporations, all of which have a need for rapid and reliable communication between their corporate offices and their far-flung operations have made private line links spanning half the globe so common as to be nearly unworthy of comment. Nevertheless, the cost of staying in such close touch at great distances, while declining steadily over time, remains formidable. The following example (Figure 1) dramatically illustrates how voice/data multiplexing with digital DS0 service can not only result in the transfer of a significant sum from the carrier's bank balance to the subscriber's bottom line, but can lead to efficiencies in data communication, as well.

A large Japanese firm headquartered in Osaka has major operations in San Diego. The two sites are connected by five analog private lines. While the seven-hour time difference results in a very narrow "business day window," the link was justified not only by voice, but by very heavy fax and modem traffic which kept the link active nearly around



MONTHLY CHARGES

ANALOG TIE LINES: 5 X $14,500 = $72,500/month*
DIGITAL DS0: $16,800/month*

INSTALLATION & EQUIPMENT COSTS

ANALOG: 5 X $1,880 + 3,300 = $12,700
DIGITAL: $2,900 + 19,000 [2 CS4100'S] = $21,900

SAVINGS

MONTHLY: $55,700
PAYBACK: $21,900/55,700 = 0.40 months

**SOURCE: MCI INTERNATIONAL, 2/89.*

Figure 1: International Tie Line Replacement

the clock. Still, the distance involved, 5650 miles, transformed what would otherwise be a somewhat modest network into an annualized expense of US$870,000.

Although the traffic was not heavy enough to warrant full T1 service, MCI International could provide a DS0 at 56 or 64 kbps for a monthly charge of $16,800. Implementing the DS0 with a voice/data multiplexer (four voice channels and one synchronous data channel) at each end of this link provided the company with four high quality, compressed-voice channels transparent to both fax and modem signals, plus a dedicated full synchronous data connection. Because the multiplexers are programmable to allow dynamic allocation of the DS0's 64-kbps bandwidth, a late-night period could be set aside to allow batch communication at relatively high speed (38.4 kbps) while still keeping one voice channel in service. Even with all four voice channels in service, the new network could still run data full time at 19.2 kbps.

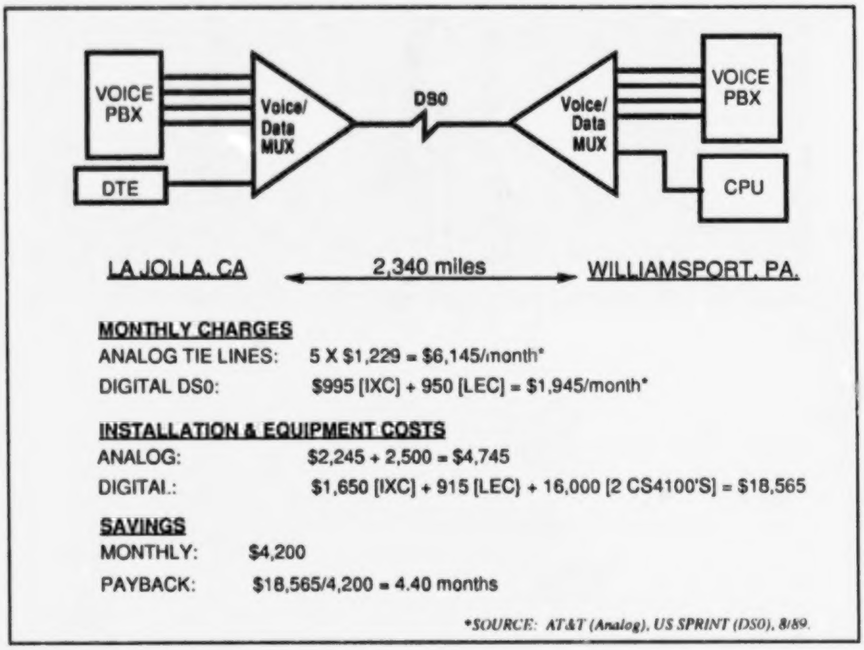
The savings in this case were nothing short of astonishing. The previous monthly cost of US$72,500 immediately declined to $16,800. Annualized, the savings amounted to US$668,400 (over two-thirds of a million US dollars). The US$19,000 investment in multiplexer equipment was essentially negligible. It was recovered in two weeks!

Replacing Point-to-Point Domestic Trunks

The impact of the new domestic tariffs when coupled with digital voice compression in a typical long-haul application is shown in Figure 2. In this case, an administrative and sales office is tied to a major warehouse and factory. In this example, the two locations are just over 2,300 miles apart, but both are within the USA. The cost of the digital DS0 service is approximately $2,000 per month with about half of that allocated to the interexchange portion and the other half to the local exchange portion. The local exchange portion is so expensive because DDS access was required. Knowledgeable industry observers, however, predict that these rates for local access will decline dramatically as hubless DDS services become fully tariffed at the local exchange level.

The cost of an equivalent number of analog private lines for this distance is about $1,230 per month. Since five of these would be required to do the work of the single DS0 circuit coupled with a four voice, one data channel multiplexer, the monthly cost savings between the two approaches is approximately $4,000. Assuming acquisition and installation costs for the multiplexers and digital circuit total approximately $20,000, the payback period for the capital investment in this instance is approximately five months. Savings for the project over the initial two years of its life will therefore be about $76,000.

In both of the above examples, it should be clear that getting the most out of the circuit means that the multiplexer must efficiently encode voice using every available bit of the digital stream. The ATC scheme, at least as implemented by PCSI, is an embedded coding scheme in which the digital data rate can be varied in very small increments as transmission capability varies. For example, in the domestic scenario, the data rate remaining after both the user data port of 9.6 kbps and framing and diagnostic data are removed, is approximately 46 kbps (assuming the data rate of the leased service is 56 kbps). The data rate per



MONTHLY CHARGES

ANALOG TIE LINES: 5 X $1,229 = $6,145/month*

DIGITAL DS0: $995 [IXC] + 950 [LEC] = $1,945/month*

INSTALLATION & EQUIPMENT COSTS

ANALOG: $2,245 + 2,500 = $4,745

DIGITAL: $1,650 [IXC] + 915 [LEC] + 16,000 [2 CS4100'S] = $18,565

SAVINGS

MONTHLY: $4,200

PAYBACK: $18,565/4,200 = 4.40 months

*SOURCE: AT&T (Analog), US SPRINT (DS0), 8/89.

Figure 2: Long Haul Domestic

voice channel can therefore be about 11.5 kbps. Users should avoid multiplexers which cannot flexibly assign data rates to voice channels in small increments to get maximum utilization and maximum quality in the application.

More complex examples of multiple site networks can be presented, but the basic principle is the same as in these two examples. That is, when sufficient voice traffic flows between fixed points, the best and most cost effective alternative will be one of the new DS0 services with voice compression and voice/data multiplexing as described above. Our research shows that circuits as short as 100 to 200 miles will provide economic paybacks so great that the multiplexing equipment pays for itself in less than 18 months. Where specially constructed local access charges are available, such as in Bell South and Pacific Bell territories, the mileage cutoff can be even lower.

Economic forces can and do transform solutions that once were merely technical possibilities.into operationally preferred alternatives. Such is the case with the lower digital rates which have completely inverted the traditional cost structure of analog and digital services in the US. Around the world, this trend is also being felt, albeit not with quite the dramatic swiftness that has occurred in the US. For some time now international links have enjoyed analog and digital tariffs which are nearly at parity with each other. It is for that reason that specialized voice compression multiplexers have been most readily accepted on intercontinental circuits. Now even relatively short domestic circuits can make use of these DS0 services as these digital tariffs have come to parity with analog private line rates.

The breakthrough in voice compression technology, both the mathematically inspired software and the more highly integrated silicon circuitry, completes the other side of the economic equation. That is, the equipment has become small enough, capable enough, and inexpensive enough that it pays for itself in transmission savings within months rather than years.

As stressed throughout, a number of operational requirements must be met by any voice compression scheme to make it completely useful in a corporate setting. These include voice quality, transparency to modem and fax signals, ability to tandem through corporate or public switches, and finally, economic savings and resistance to technical obsolescence. If the user is careful in qualifying candidate equipment on these points, and also in financially analyzing his particular situation, he will find great benefits in moving into the new world of DS0 and fractional T1 transmission.

Session 3.3

Fiber Optics - Technology and Systems

NOTES

UNDERSEA COMMUNICATION COMES OF AGE - THE LIGHTWAVE ERA

S. T. Brewer

ABSTRACT

The first transatlantic telephone system in 1956 was a major breakthrough in how we communicate across oceans. This link carried voice and data with a quality and freedom from errors which users welcomed. To meet ever increasing demand designers and manufacturers created four generations of analog cables. However, by the mid-70's coaxial technology had run low on steam to achieve a major increase in capacity. Fortunately, there was an option; system developers worldwide turned to the young, but promising lightwave technology that was just emerging from research laboratories.

The push to lightwave technology in the 70's and 80's has borne ample fruit. Starting in 1985, Optican 1, a short Canary Islands link, confirmed that our lightwave technology was generally on target for transoceanic service. In 1988, we installed the world's first transoceanic optical system, TAT-8, linking England, France, and the United States. Later, Transpacific-3 and HAW-4 joined Japan to the United States mainland. Thus, talkers and data users communicated all the way from Europe to Japan over digital lightwave facilities - truly a historic first!

Today, the network of first generation optical cables continues to grow apace. Second generation hardware is in manufacture, and many links in the Atlantic and Pacific are already on the books. Second generation systems extend earlier technology to achieve twice the capacity and increased economy. By 1993 these newer systems will be serving over major Atlantic and Pacific routes and reaching out to many of the developing nations.

What about third generation lightwave systems? In the last decade, researchers have spawned an incredible variety of advanced technologies. Furthermore, technologies used in first and second-generation systems have not run out of steam. I believe that some of the advanced technologies will be used in future generations of undersea systems.

In any case, we may expect lightwave undersea systems to serve more and more users with low-delay, quiet communications. We may expect that emerging technologies will continue to reduce the cost of service. Yes, undersea communications has come of age. We have entered fully the lightwave era.

1. INTRODUCTION - TELEGRAPH & RADIO ERA

1.1 TELEGRAPHY

In 1866 the first successful transatlantic cable was completed. This ushered in a new era. For the first time, people could read current news in their papers even though it involved happenings far away. The telegraph era extended to 1956 when the first voice transatlantic cable was completed. As a legacy, the telegraph era firmly established the following points:

The first was that cables worked. (Some skeptics doubted that signaling currents would get across the ocean.)

The second point was that properly designed cables could be laid and maintained in the deep ocean over a long useful lifetime. Despite the wonderful legacy they left, telegraph cables provided the merest hint of miracles to come.

1.2 RADIO

Radio deserves credit for the first voice transmitted across the Atlantic ocean. Commercial voice service began in 1927. For almost thirty years, radio was the only means of voice communication across the oceans. Unfortunately, it was expensive. Furthermore it suffered limitations of quality and availability caused by propagation difficulties.

2. COAXIAL SYSTEMS

2.1 ANALOG COAXIAL CABLES

The installation of the first transatlantic telephone cable in 1956 brought high quality voice communication across the ocean. The enthusiastic response of users led to doubling of traffic every three years. To meet this burgeoning demand, four generations of analog cables were developed. The first and fourth generations are highlighted in Table 1. The first generation system used modest performance electron tubes. The fourth generation system used advanced silicon transistors and made limited use of silicon integration circuits. By exploiting this advanced technology the capacity of a cable system grew from 100 voice conversations to 10,000.*

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*With Time Assignment Speech Interpolation

TABLE 1

PROGRESS IN CAPACITY

FACILITY	YEAR	SYSTEM CAPACITY Mb/s	VOICE CONVER-SATIONS	COMMENT
TAT-1, SB	1956	0.5	100*	First transoceanic telephone cable analog, electron tubes
TAT-6,7 SG	1976/83	40	10,000*	Fourth generation analog, Si transistors
HAW-4/TPC-3 SL-280	1989	560	40,000†	Digital optical 1310 nm
HAW-5/TPC-4 SL-560	1992	1120	80,000†	Second generation optical 1550 nm

* Assumes Time Assignment Speech Interpolation Expansion Factor = 2.5

† Assumes Digital Circuit Multiplication Equipment Expansion Factor = 5.0

TABLE 2

COAXIAL AND FIBER OPTIC SYSTEM ECONOMICS

YEAR	SYSTEM TYPE	VIRTUAL CHANNEL RELATIVE COST
1956	First generation coaxial	60*
1976	Fourth generation coaxial	2*
1988	First generation fiber optic	1†
1992	Second generation fiber optic	0.5†

* Assumes Time Assignment Speech Interpolation Expansion Factor = 2.5

† Assumes Digital Circuit Multiplication Equipment Expansion Factor = 5.0

2.2 COAXIAL CABLE ECONOMICS

Refer to Table 2. Advancing technology and higher capacity per system had a dramatic effect on transmission economics. As we see, a virtual channel of the fourth generation coaxial system cost 1/30th as much as a channel in the first generation system. At the same time, the fourth generation systems provided improved transmission quality and maintained the reliability standards of earlier systems. These standards called for no more than three failure-induced ship repairs over a twenty-five year lifetime.

3. FIBER OPTICAL CABLES - OVERVIEW OF SYSTEMS

Again, see Tables 1 and 2. The Hawaii-4/Transpacific-3 systems are typical of the first generation optical links. The AT&T SL-280 system serves for Hawaii-4 and half of Transpacific-3. (TPC-3 was provided jointly by KDD in Japan and AT&T in the United States.) These links carry 280 Mb/s on each of two working fiber pairs for a system capacity of 560 Mb/s. A spare pair protects against failure in either working pair. In the AT&T section of this link, the protection has complete flexibility. Thus, between any two repeaters and in either direction, shore control can shift transmission from either working path to the spare path.

The second generation system carries twice as much traffic as the first but uses the same fiber and cable design. Despite its higher capacity, the cost of the second generation system is lower than that of the first, thanks to its operation in the low-loss 1550 nm optical window. At this longer wavelength, fiber loss is about 55% of its loss at 1310 nm. The net effect of the changes is that second generation fiber optic systems provide service at a cost per virtual channel about one-half that for first generation systems. Comparison with coaxial system economics is more dramatic; a second generation optical system provides a virtual channel for one-fourth the cost in the fourth generation coaxial system.

Later in this paper we will look at the differences between first and second generation lightwave cable systems in greater detail.

4. NON-REPEATERED SYSTEMS

4.1 GENERAL

A significant development in the lightwave era is the non-repeatered system. The huge information capacity of optical fibers and their low loss make this type of system possible. Such a system combines standard undersea cable hardware and placement techniques with high-performance terrestrial terminals. For terrestrial systems, long repeater spacing is not of great importance. However, for non-repeatered undersea systems the capability of spanning long distances is vitally important. Hence, for undersea systems, we use terrestrial terminals with specially enhanced optical performance.

4.2 CURRENT TECHNOLOGY - THE TAINAN-PENG HU LINK

Figure 1 shows the Tainan-Peng Hu system, which went into service in mid-August 1988 in Taiwan. This link uses AT&T FT Series G terrestrial terminals. The optical transmitters and receivers of these terminals operate in the low-loss fiber window at 1550nm. Also, the laser transmitters provide higher power output, and the optical detectors provide greater sensitivity than those of the standard terminals.

The Tainan-Peng Hu system is 104 km long and contains eight optical fibers. Four of the fiber paths were equipped with terminal transmission equipment (TTE's). Four fibers are reserved for future use. Each fiber pair is capable of carrying nine DS3 signals of 672 channels each. The installed system provides excellent optical margins, varying from 16 to 18 dB. This is enough reserve margin that the system could have spanned more than 150 km while meeting all performance criteria.

4.3 NEXT YEAR'S TECHNOLOGY

For further details on the Series G and comparison with next year's technology let's look at Table 3. The FT Series G is designed for the North American hierarchy. The interface is at the DS3 level of 45 Mb/s. However, with added multiplex, the system can serve CEPT or other hierarchies.

The newer SL 622 NR system operates at the SONET level of 622 Mb/s. It can interface with any of the world's digital hierarchies. The dramatic gain of the SL 622NR system is in distance capability. Whereas the FT Series G maximum span is 150 km, the SL 622NR can span 260 km with ample system margins.

FIGURE 1

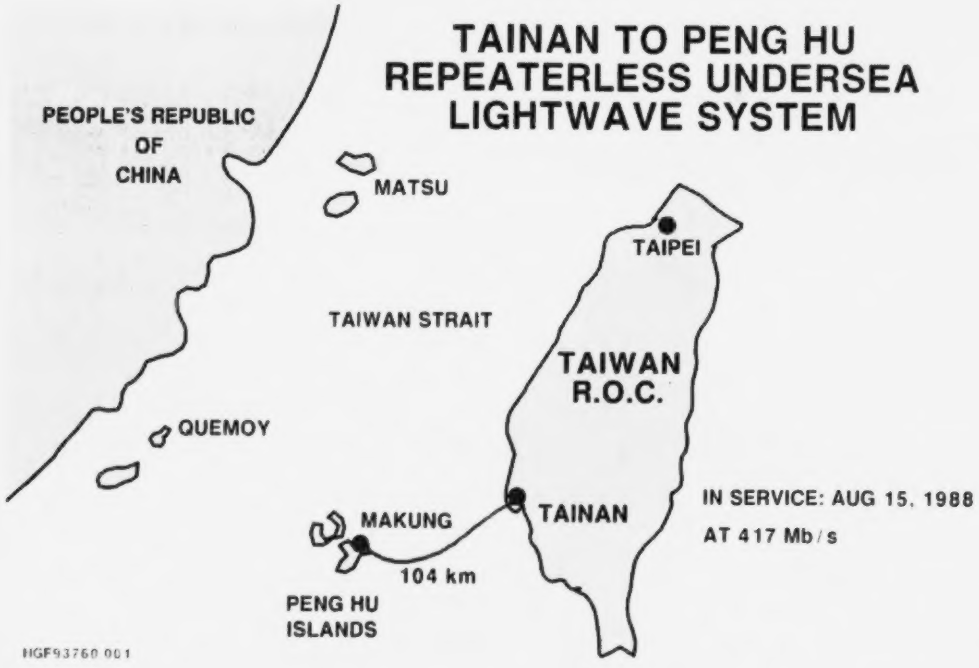


TABLE 3

NON-REPEATERED SYSTEM EXAMPLES

	CURRENT	FUTURE('91)
NAME	FT Series G	SL-622 NR
STANDARD	North American	CCITT SONET
LINE RATE	417 Mb/s	622 Mb/s
WAVE LENGTH	1550 nm	1550 nm
MAX SPAN	150 km	260 km
CHANNELS/PAIR	6048	8064
MAX CHANNELS/SYSTEM (six fiber pairs)	36 288	48 384

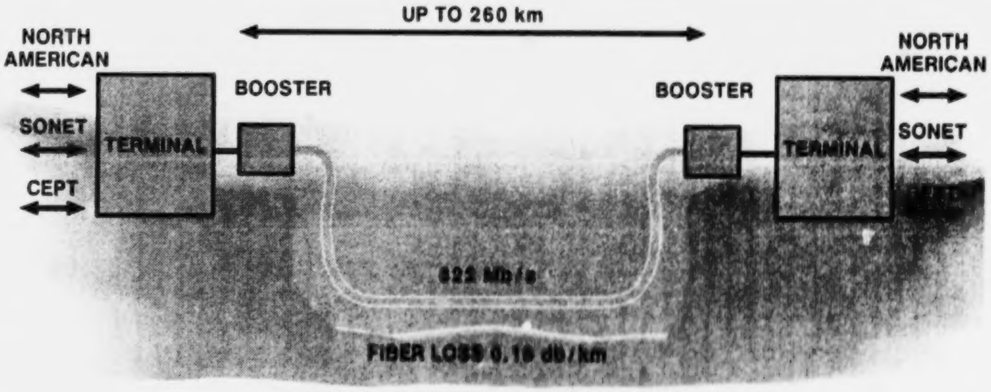
4.4 ELEMENTS OF A NON-REPEATERED SYSTEM

Figure 2 shows the elements of a non-repeatered system using the SL 622NR technology. Note that completely standard terrestrial terminals are supplemented by *external* boosters on the undersea cable side of the terminals. These boosters have three important functions:

- They change the operating wavelength from 1300nm to 1550nm.
- They increase the optical transmitted power.
- They increase the receiver sensitivity.

FIGURE 2

AT&T'S NONREPEATERED SYSTEMS


UP TO 260 km
NORTH AMERICAN
SONET
CEPT
TERMINAL
BOOSTER
BOOSTER
TERMINAL
NORTH AMERICAN
SONET
622 Mb/s
FIBER LOSS 0.18 db/km

- OPERATE IN 1550 nm WINDOW
- CAN HANDLE UP TO 54dB OPTICAL LOSS
- USE STANDARD TERRESTRIAL TERMINAL

These changes allow the modified terminals to handle up to 54 dB of total optical loss. When we use these terminals with undersea cable having a loss of 0.18 dB/km, the resulting link can span 260 km.

4.5 NON-REPEATERED SYSTEMS - SUMMARY

In summary we see that the advantages of non-repeatered lightwave systems are:

- lower costs:
  - — undersea repeaters and their monitoring equipment and power feed equipments (PFE's) are eliminated
  - — low-cost terrestrial terminals are used
- upgradability of capacity for future needs by changing terminals
- wide range of options on interfaces and capacities
- capability of serving increasingly long spans.

5. THE GROWING WORLD NETWORK

5.1 LONG TRANSOCEANIC LINKS

Figure 3 shows some existing and planned installations of AT&T's optical undersea systems. Most of the systems shown represent first generation SL 280 technology. However, TAT-9 will use the second generation SL 560 system. The future Transpacific-4 and Hawaii-5 cables will also use second generation technology.

The TAT-9 link will pioneer in two respects:

1. It will link more countries than any earlier system, namely, England, France, Spain, Canada, and the United States.
2. The system will contain underwater branching multiplex. This will allow traffic reconfiguration controlled from the shore. Signals can be sent to steer 45 Mb/s or 140 Mb/s blocks of traffic to different destinations based on traffic demands.

FIGURE 3

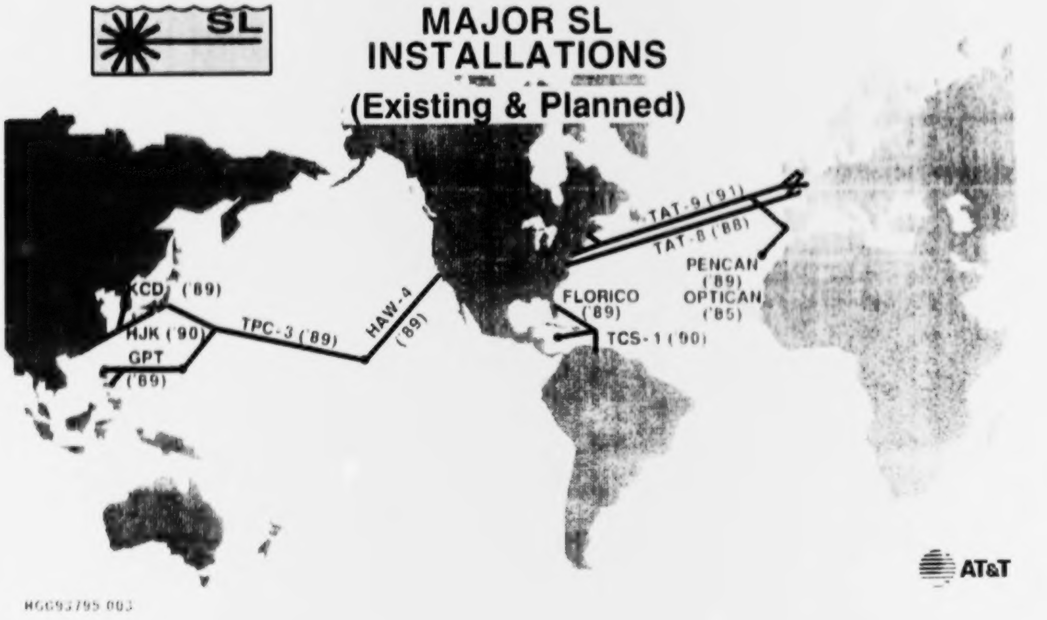


TABLE 4

SL-280 PARAMETERS

(TAT-8, HAW-4, TPC-3, GPT)

Working fibers	4
Protection fibers	2
Line rate, each fiber	295.6 Mb/s
Line code	24B1P
System interface	140 Mb/s
Channels per interface port	1920
Channels per system	7680
Conversations/system*	40 000

*** Using Digital Circuit Multiplication Equipment, DCME**

5.2 FIRST GENERATION SYSTEM PARAMETERS

For a more detailed look at the parameters of first generation systems, refer to Table 4. This table refers to the SL-280 technology used in the Transatlantic-8, Hawaii-4, Trans-Pacific-3, and Guam-Philippines-Taiwan. These links use a 24B1P code. The parity bit in each block is used for error monitoring. A selected sub-group of the parity bits carries signals from the SCOUT (System COntrolling Undersea Transmission) equipment to the supervisory circuits of the undersea repeaters.

On the terrestrial side, the system interfaces at 140 Mb/s. This is the CEPT 4 level. Besides fitting in well with the CEPT hierarchy, this interface can efficiently carry three DS3 signals in the 140 Mb/s stream. Digital Circuit Multiplication Equipment (DCME) added on the terrestrial side of these systems can give a gain in capacity of 5-to-1 or more for voice communication. The gain in capacity also applies to voice-band data at rates up to 4800 b/s. The DCME is normally placed in the communications gateway, rather than in the undersea system cable station. This placement reduces the gateway-to-cable-station channels by the 5-to-1 DCME concentration factor.

5.3 PERFORMANCE RESULTS - TAT-8

Since TAT-8 was the first transoceanic fiber optic system, it's error performance is of great interest. Table 5 summarizes the performance of this link during April and May of 1989.

The TAT-8 system error performance on the 140 Mb/s tributaries is determined through parity violations. These violations are logged on the two 140 Mb/s tributaries between the United States and England, and on the two 140 Mb/s tributaries between the United States and France. This is routine practice in following the system performance. The results of these four error logs over the two month period are displayed in Table 5. Because of sound system design and ample span margins, the performance shown far exceeds the system requirements. For example, note that the observed Bit Error Ratio (BER) is more than 5-1/2 orders of magnitude better than the requirement. From a user's viewpoint, this means that transmission distance adds no detectable noise to voice or other analog services.

TABLE 5

TAT-8 PERFORMANCE RESULTS

PARAMETER	REQUIREMENT	OBSERVED PERFORMANCE
ERRORED SECONDS PER DAY	NOT SPECIFIED	1.5
SEVERELY ERRORED SECONDS PER DAY AVERAGE	≤ 3.4	0.04
DEGRADED MINUTES PER DAY (30 DAY AVERAGE)	≤ 7.3	ZERO
OUTAGES PER YEAR	≤ 0.00018	ZERO
BER, 24 HOUR AVERAGE	$\leq 3.7 \times 10^{-8}$	10^{-13}

Note: All Figures Given are Average of Performance On Four 140 Mb/s Lines Observed During April and May '89

TABLE 6

TWO OPTICAL UNDERSEA SYSTEM GENERATIONS

	1st GEN SL-280	2nd GEN SL560
MAX NO. OF FIBERS	6	6
LINE RATE, Mb/s	296	591
LASER TYPE	BH	DFB
OPTICAL DETECTOR TYPE	PIN	APD
OPTICAL WAVELENGTH, nm	1300	1550
REPEATER SPACING, km	70	150
CONVERSATIONS PER SYSTEM	40 000	80 000

5.4 FIRST & SECOND GENERATION COMPARISON

For a comparison of the first and second generation optical undersea systems, see Table 6. The most important difference is that the second generation system has twice the capacity per fiber pair. The 591 Mb/s line rate allows the second generation system to carry four 140 Mb/s information tributaries per fiber pair, while the first generation system carries only two. In a system with two working fiber pairs, the second generation system can carry 80,000 conversations vs. 40,000 conversations for the first.

The first generation system uses a BH laser with a spectral width of 2.0 nm. This width does not result in a significant optical dispersion penalty because signals are carried over an optical fiber whose dispersion is zero at 1310 nm. The second generation SL 560 system uses a Distributed Feedback (DFB) laser with a spectral width of 0.1 nm. Side modes are 30 dB or more below the principal mode. The DFB laser allows the use of the same fiber that was used in the first generation system, even though the fiber has a dispersion of 18 ps/nm km. The avalanche photodiode (APD) which the second generation system uses increases the optical detection sensitivity by 7 dB over that of the PIN diode. Operation of the second generation system in the optical fiber's "third window" at 1550 nm reduces the transmission loss to about 55% of the loss in the 1300 nm "second window." The reduced loss, plus the increased sensitivity provided by the APD gives the second generation system a repeater spacing of 150 km. This is a major increase over the 70 km achieved by first generation technology.

5.5 UNDERSEA SYSTEM MONITORING & CONTROL

The SL 280 system monitors and controls the undersea repeaters through the SCOUT system. The second generation system (SL 560), performs similar operations, but in an integrated equipment that combines *undersea* functions with other monitoring and maintenance activities.

Table 7 shows the repeater functions performed in present lightwave undersea systems. The cumulative BER is a summary performance indication. Laser bias current is a measure of laser aging, while the input amplifier AGC voltage shows the strength of the received optical signal.

Repeater monitoring determines and verifies the status of switches that put spare transmitters in service or transfer signals to the protection path. Through its monitoring and verifying, SCOUT updates its health and configuration map of the undersea system.

SCOUT commands the switching to a spare laser transmitter or to a protection path. These actions are programmed to occur automatically under failure conditions. Station staff take command in more complex situations.

5.6 FUTURE TECHNOLOGIES

It is too early for any detailed outlining of third generation systems. Nevertheless, let's take a look at some of the technologies that hardworking researchers have created. Refer to Table 8. The optical amplifier takes a couple of forms; it can be a laser amplifier or a distributed fiber amplifier. Maximal use of an optical amplifier would compensate the fiber loss of the preceding cable span. Because the optical amplifier does not regenerate the signal, it must be used carefully to avoid the introduction of unacceptable errors. Optical amplifiers can also be used as preamplifiers or post amplifiers to a conventional regenerator.

Coherent transmission is attractive because of the large gain in detection sensitivity. The theoretical gain is 20 dB. This large gain is especially attractive in allowing longer spans for nonrepeatered links. Regarding ultra low loss fibers we are referring to halides and other nonsilica glasses. These "exotic" glasses are not nearly ready for field operations, so their future use remains speculative. Nevertheless, their theoretical losses are so low that we cannot ignore their potential. In principle, we may one day cross the ocean without *any* undersea repeaters!

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TABLE 7

SCOUT REPEATER FUNCTIONS

MONITORS

- BER (THROUGH PARITY VIOLATIONS)
- LASER BIAS CURRENT
- AMPLIFIER AGC VOLTAGE

VERIFIES

- STATUS OF SPARE LASER SWITCHING
- STATUS OF REPEATER TRANSPOSITION AND LOOPBACK SWITCHING

COMMANDS

- SWITCHING TO SPARE LASER TRANSMITTER
- SWITCHING TO PROTECTION PATH OR LOOPBACK AT REPEATER

NOTE: SCOUT = System COntrolling Undersea Transmission

TABLE 8

WHAT'S NEXT?

- Optical amplifier linear repeater
- Coherent optical communication
- Ultra-low loss fibers
- Optical Soliton Transmission
- Very high bit rate direct detection
- Wavelength division multiplexing

Optical soliton pulses take advantage of the nonlinear Raman effect to preserve a pulse shape and minimize dispersion penalties. Therefore, solitons could be used to achieve extremely high data rates. Regarding very high rate direct detection, 8 Gb/s is feasible today, and this capability may go up by a factor of two in the future. Wavelength Division Multiplexing (WDM) would be used if the capacity needed is greater than the technology can provide at a single wavelength.

With such a rich offering of advanced technologies, it is likely that third generation systems will use some of the new techniques to complement those of first and second generation systems. These newer technologies will bring a major increase in system capacity. They will add momentum to the trend toward higher quality and greater economy in world communications.

6. A LOOK AHEAD

Where are lightwave undersea systems headed in the next ten years? Here are my personal guestimates:

- Capacities on major trunk routes will grow enormously. Limits will be controlled more by user demand than limitations of technology.
- Costs per circuit on trunk routes will continue their sharp downward trend.
- Costs on low traffic routes will decrease, but at a lower rate.
- Facility planners will turn to nonrepeatered systems on a large scale. The superior performance, economy, flexibility, and increasing distance capability of the systems will be the driving forces in this development.
- A worldwide, self-healing network will evolve to give users unprecedented quality and continuity of service.
- Advanced technologies will continue to increase the capacity of future cable systems and to sharply reduce the costs to the communications user.

In the September, 1985 "Communications Magazine," I gave this forecast; "By the year 2000, (such) high density routes will see commercial undersea lightwave systems carrying ten gigabits per second in a single cable." At the time this seemed like an adventurous forecast, but from today's perspective, I may have been much too conservative!

Acknowledgement:

I extend my deep personal thanks, and the thanks of the growing millions of people who use world communications, to the many people worldwide who play important roles in optical fiber undersea systems. It is these creators, designers, and doers who have brought us full-blown into the Lightwave Era.

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THE SOUTH PACIFIC OPTICAL FIBRE SUBMARINE CABLE NETWORK

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1. ABSTRACT

The paper outlines the current status of plans for the establishment of the TASMAN 2, PacRimEast and PacRimWest optical fibre submarine cables planned for service in the early 1990s. With other cables planned for the Pacific Region they will provide a secure, high quality, digital communications network connecting major commercial centres in the region and beyond. Technological developments in optical fibre submarine cable technology, its impact on submarine cable planning, and opportunities for new and innovative services presented by the availability of a high quality digital network are also considered.

2. INTRODUCTION

Plans for the establishment of the South Pacific Optical Fibre Submarine Cable Network are now in place. The network will link Australia and New Zealand to Japan and the USA.

The South Pacific Network is one of a number of optical fibre submarine cable projects planned for the Pacific Ocean Region. By the mid 1990s a substantial optical fibre cable network linking Australia, New Zealand, Asia and North America will be operational and will link the rapidly growing Pacific rim countries into the developing world digital network.

3. PACIFIC REGION DEVELOPMENT

The high growth in the Asia Pacific region shows no signs of slowing down, and necessitates the planning of modern regional telecommunications systems, including submarine cables, to support the rapid development taking place.

A number of optical fibre submarine cable projects have been firmly planned or proposed for the Pacific Region. These will dramatically expand the capacity of the existing analog cable network (Figure 1). Figure 2 shows that a major closed loop network of optical fibre submarine cables interconnecting the major commercial centres in the region will be in place by the mid 1990s. Connection with major commercial centres on the eastern seaboard of North America and in Europe will also be available at that time via optical fibre cable systems across North America, the Atlantic and the Mediterranean, and possibly via SE Asia and the Indian Ocean.

Through the developing digital optical fibre cable network, encompassing the globe by the mid 1990s, South East Asia will be linked to Europe, the Middle East and North America. This global connectivity will facilitate the rapid introduction of digital communications services between the major commercial centres, meeting the growing expectations of commerce and stimulating even greater demand for high quality digital telecommunications.

Already, elements of the Pacific Optical Fibre Submarine Cable network are entering service. The first system, HAW-4/TPC-3, was placed in-service during April 1989 and connects USA-Hawaii-Guam/Japan, with an underwater branching unit in the Hawaii-Guam/Japan Sectors. Figure 3 depicts those elements of the Pacific Digital Network already in-service.

The new digital communications infrastructure will serve as an enabling agent, catalysing the introduction of new services such as ISDN, (particularly broadband ISDN), broadband private lines, videotelephone, teleconference and other video applications.

4. THE SOUTH PACIFIC CABLE NETWORK

Since the mid 1960s, Australia and New Zealand have been connected by analog submarine cable to North America (initially via COMPAC, and currently via the ANZCAN Cable) and to Asia (initally by SEACOM, and currently via the A-I-S Cable), as depicted in Figure 1. The current analog cable links will be fully utilised around 1993 (ANZCAN) and 1994 (A-I-S). This factor has made it necessary to plan the provision of additional cable capacity in a matching time frame, to ensure that an appropriate level of cable and satellite diversity is maintained on these major routes.

The proposed development timeframe coincides with the growing demand for quality digital services, and with the rapid evolution of the world optical fibre submarine cable network.

The South Pacific Cable Network was planned to meet this need and consists of three optical fibre submarine cables. These are the TASMAN 2, PacRimEast and PacRimWest cable systems. When operational in the mid 1990s, these cables will interconnect with other planned Pacific Region cables to provide a high quality secure digital communication network servicing the Pacific rim countries. Figure 2 highlights their linkage in the Pacific digital closed loop network.

An important strategic element in the evolution of the Pacific cable network is the self healing closed loop. This structure is realised by interconnection of the South Pacific Cable Network with other Pacific Cable Systems, to form a closed loop. Provided the cables comprising the loop are appropriately dimensioned, any single break event in the loop transmission path can be restored via the remaining part of the loop. This network structuring is planned to secure high reliability of Pacific communication services.

Two network planning principles that are exercised to increase the level of service security are route diversity and assured restoration. Adequate and on demand cable restoration (as has been possible in the past) may not always be available on Intelsat in the future because of capacity constraints. Consequently, planning needs to ensure that the security of service is provided from within the regional cable network. The provision of additional cable capacity for this purpose has now become possible because of the high capacity/low marginal cost characteristics of the new optical fibre cable technology.

OTC (OTC Limited, in Australia) and TCNZ (Telecom Corporation of New Zealand, Ltd) began planning the South Pacific Cable Network in 1985 when discussions were initiated with industry and correspondent carriers. A research and development program was initiated at that time to foster OTC in-house and Australian industry knowledge and capability in the domain of the new optical fibre cable technology. This successfully laid the foundation for local industry initiatives, including the establishment of the Tasman Cable Company.

Late in 1986, detailed discussions commenced between OTC, TCNZ, KDD (Japan) and AT&T (USA) to integrate planning and development of the South Pacific Cable Network as part of the overall proposed Pacific Loop Network.

5. TASMAN 2

The TASMAN 2 cable is the first stage in the establishment of the South Pacific Cable Network. TASMAN 2 will connect Sydney, Australia with Auckland, New Zealand and is planned to be in-service by December 1991.

Tenders were called for TASMAN 2 in December 1986, and on 4 November 1987, the TASMAN 2 purchasers, OTC and TCNZ, announced that Submarcom in conjunction with Alcatel - STC Pty Ltd of Australia had been selected as the prospective system contractor. The Contract was signed in December 1987 with the contractor being the Tasman Cable Company (TCC, a company owned by Alcatel - CIT and Les Cables de Lyon of France, and Alcatel - STC Pty Ltd of Australia).

TASMAN 2 will be a 1550 nanometre wavelength single mode optical fibre submarine cable system with 19 submerged repeaters and fish bite protection to a depth of 2.5 km. It will have three fibre pairs configured as two working traffic fibre pairs, and one protection fibre pair. Each fibre will operate at 560 Mbits/s, and be capable of providing 7560 MAUOs (minimum assignable unit of ownership, each equivalent to one 64 Kbit/s circuit). With a late 1991 in-service date it will be one of the first long-haul submarine cables in the world to operate at 1550 nanometres and 560 Mbits/s.

The capital cost for the submarine cable segment (and the Sydney and Auckland cable stations) is around US$110 million, and is to be shared equally between OTC and TCNZ.

The cable will be manufactured in Australia at a recently commissioned TCC cable factory at Port Botany, NSW, from locally sourced materials. Repeaters will be locally produced in Sydney by TCC, while terminal transmission and power feed equipment will be manufactured in New Zealand. Cable production is planned to commence in early 1990, with laying operations following in mid 1991. The Ready For Service is planned for December 1991.

6. THE PACRIM CABLES

In September 1987, after some 12 months study, the PacRim Initial Parties (AT&T, KDD, OTC and TCNZ) announced in Kyoto, Japan, the signing of an agreement to co-operate in planning the construction of the PacRimEast and PacRimWest cables. The Parties also agreed to co-operate in the establishment of other subsequent stages of optical fibre submarine cable network development in the Pacific basin.

The PacRim cables will each comprise two fibre pairs operating at 560 Mbit/s, with one fibre pair providing a design capacity of 7560 MAUOs, whilst the second fibre pair provides a protection capability.

The anticipated capital cost (including cable stations) is around US$560 million for the 14,700 km two cable system.

Since 1987, PacRim has progressed under the project management of an Interim Management Committee, comprised of representatives of Parties to the PacRim Initial Agreement. Currently the total number of Parties participating in the project number thirty two.

On 29 September 1989, Construction and Maintenance Agreements (C&MAs) for each PacRim cable were initialled, signifying agreement in principle amongst Parties to the terms and conditions of the C&MAs and their intention to seek to secure the approvals required for their participation in the project as PacRim owners.

System specifications have now been completed and Requests for Proposals for both cable systems were issued to the prospective suppliers, AT&T and TCC (Tasman Cable Company) during December 1989.

Marine surveys of the proposed routes will be completed for both systems during 1990. The confirmed routes will then permit finalisation of proposals by the potential suppliers. The scheduled supply contract and C&MA execution date is the end of 1990. Ready for Service is targeted for first quarter 1993 for PacRimEast and fourth quarter 1994 for PacRimWest.

7. TECHNOLOGICAL DEVELOPMENTS

The first major trans-Atlantic and trans-Pacific optical fibre submarine cable systems entered service in 1987/8 (Figure 3). They are 1,300 nanometre wavelength systems operating at 280 Mbit/s with repeaters spaced at 50 to 70 kilometres and using two fibre pairs to provide generally 7,560 MAUOs of capacity per system.

These are large capacity cables relative to coaxial cable capacities, but already, second generation optical fibre cable designs, operating at 560 Mbit/s, such as that proposed for TASMAN 2 and TPC-4, with yet higher capacities and lower unit cost structures have already been planned.

The possibility of larger capacities (such as the 1.2 Gbit/s and 2.4 Gbit/s systems) being developed by the mid to late 1990s and the low marginal cost of additional capacity pose a challenge to submarine cable planners - to take an entrepreneurial approach, investing marginally more capital to build a substantially larger cable and using the additional capacity to provide resoration capacity and to stimulate new broadband service development and new applications.

The developing competitive environment and the potential for the continuing development of new applications and services would also seem to favour the large capacity technology choice.

8. INSTITUTIONAL CONSIDERATIONS

New cable systems require the issues of system sizing, cost implications, and associated owner investment arrangments to be evaluated. Underlying this decision process are the guiding factors such as meeting the public interest, satisfying customer demand and the formation of an integrated network.

Investment arrangements were originally developed during the '60s and '70s to suit the coaxial submarine cable system environment. They have adapted to meet the new circumstances, as has been recognised to a degree in the TAT-9, PacRim and other recent submarine optical fibre cable agreements where new investment and ownership frameworks have been adopted. Concepts such as "notional capacity" and "common reserve capacity" have been introduced to help manage the provision of any initially unassigned capacity.

The dynamic of technology change may even lead to further developments in ownership and use concepts in future large capacity systems, such as provision of ownership in distinct usage categories.

9. MARKET/SERVICE ASPECTS

The globalisation of industry, coupled with the new network capabilities, is creating increased customer interest in security and quality of service. The new Submarine Optical Fibre Cable networks have been planned to specifically meet these customer needs.

The range of envisaged digital service developments are many, and include:

- digital value added services
- high resolution digital television (HDTV)
- colour facsimile
- ISDN, particularly broadband (B-ISDN)
- broadband private lines
- video telephone
- teleconferencing
- live television broadcast
- other video and broadband applications
- multiple transmission paths for redundant applications.

Customers have always had an underlying preference for cable circuits rather than satellite. This preference arises from the quality of via-cable service and the shorter transmission loop delay. Both factors contribute substantially to achieving the reliable, quality data transmission required by private network customers.

Unfortunately, limited cable capacity in the analog cable environment frequently meant requests for via-cable service could not be met.

The introduction of high capacity and quality digital optical fibre cables will rectify this and spur the implementation of corporate networks and revolutionary applications.

10. CONCLUSION

Plans for the South Pacific Cable Network incorporating the TASMAN 2, PacRimEast and PacRimWest cables are now firm, with in-service dates projected as 1991, 1993 and 1994.

A contract for TASMAN 2 was let in December 1987 and work is progressing on schedule. Contracts for PacRim are expected to be let by December 1990.

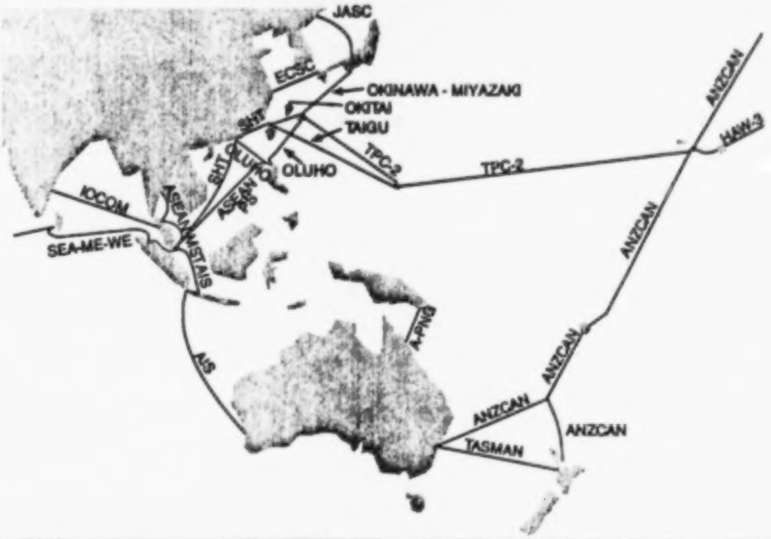
Planning has successfully targeted establishing a self healing loop network architecture to ensure maximum security of service in the mid 1990s.

As part of the developing global digital network, the South Pacific cables will provide a framework to support the introduction of new high quality digital services in the 1990s.

The authors would like to thank OTC Limited for permission to publish this work. The authors acknowledge TCNZ's assistance in reviewing a draft of this paper.

PACIFIC CABLE NETWORK
ANALOG CABLES

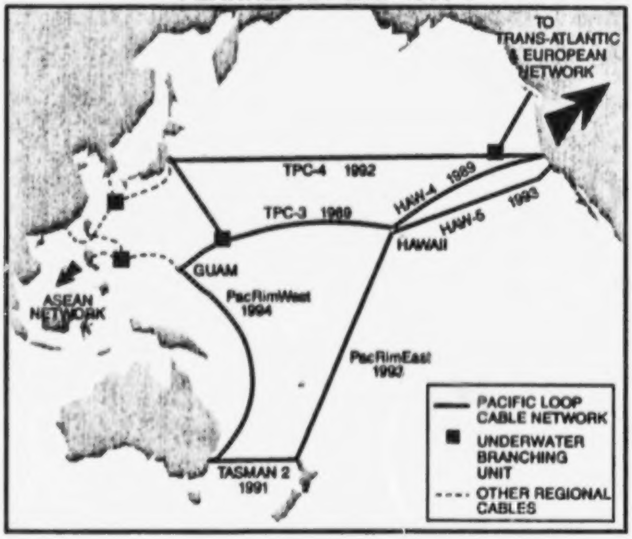
FIGURE 1


JASC
ECSC
OKINAWA - MIYAZAKI
OKITAI
TAIGU
SHT
SHT
OLUHO
OLUHO
TPC-2
TPC-2
ANZCAN
HAW-3
ASEAN
PS
IOCOM
ASEAN
STAIS
SEA-ME-WE
ANZCAN
A-PNG
AIS
ANZCAN
ANZCAN
ANZCAN
TASMAN

PACIFIC LOOP NETWORK

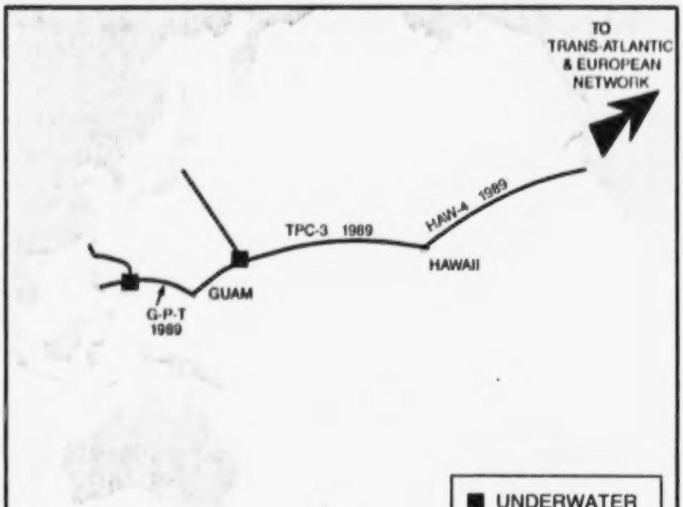
MAJOR SUBMARINE OPTICAL FIBRE CABLES FORMING A SELF-HEALING CLOSED LOOP PLANNED BY MID 1990's

FIGURE 2


TO TRANS-ATLANTIC & EUROPEAN NETWORK
TPC-4 1992
TPC-3 1989
HAW-4 1989
HAW-5 1993
HAWAII
GUAM
ASEAN NETWORK
PacRimWest 1994
PacRimEast 1993
TASMAN 2 1991
PACIFIC LOOP CABLE NETWORK
UNDERWATER BRANCHING UNIT
OTHER REGIONAL CABLES

PACIFIC SUBMARINE OPTICAL FIBRE CABLE NETWORK RFS BY JAN 1990

FIGURE 3


TO TRANS-ATLANTIC & EUROPEAN NETWORK
TPC-3 1989
HAW-4 1989
HAWAII
GUAM
G-P-T 1989
UNDERWATER BRANCHING UNIT

New Lightwave Technology Extends The Range Of Non-Repeatered Undersea Systems

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ABSTRACT

AT&T established itself in the non-repeatered undersea market in 1988 with the installation of the 417 Mb/s, 104 km Tainan to Penghu System. That system has operated error-free since it went into service in August 1988. Non-repeatered systems operating with 622 Mb/s 1.5 µm technology in 200 km spans are feasible today and future technology will expand the non-repeatered undersea market to include spans in the 200 to 300 km range at 622 Mb/s bit rate.

1. INTRODUCTION

A non-repeatered undersea system connects two terrestrial locations separated by the sea without the need for undersea regeneration of the optical signal [1]. The technology for non-repeatered undersea systems with span lengths up to 200 km is available [2]. This paper presents various technology options for future systems, including coherent detection and Erbium-doped fiber amplifiers, that have the potential of increasing non-repeatered span lengths beyond 200 km [3-7]. Optical protection switching is also presented as a novel approach to providing end-to-end services with minimal interruptions [2].

2. MOTIVATION

Lower cost and upgradable capacity are the customer motivations for choosing non-repeatered systems over repeatered systems. In non-repeatered systems, capacity can be upgraded by replacing the terminal with new higher capacity terminal, if the new terminal's loss budget permits. Non-repeatered systems may cost less than corresponding repeatered systems because of the additional cost of provisioning, operating and maintaining undersea repeaters [1]. Non-repeatered undersea systems can also offer higher capacity, better performance, and more secure communication links than microwave radio or satellite systems.

3. OPPORTUNITIES FOR FUTURE NON-REPEATERED SYSTEMS

Several applications for coastal links and inter-island links with span lengths longer than 200 km have been identified in the world. The potential market for non-repeatered systems will grow as longer span lengths are achieved. For many customers, repeatered systems for these spans are not economical. However, once longer spans are available in non-repeatered systems, these applications will open up new markets to undersea technology.

4. TECHNOLOGY

To achieve longer span lengths, higher system gain and lower cable loss is needed. Cabled dispersion shifted fiber has typically a higher loss (0.21 dB/km to 0.23 dB/km), than conventional single-mode fiber (0.18 dB/km to 0.20 dB/km). Thus, to attain the maximum non-repeatered span length, only systems designed to operate with conventional single mode fiber will be discussed in this paper.

Advances in optical fiber technology will enable low loss fiber to be available. At a given fiber loss, the system gain may be increased by using one or more of the following: higher power transmitters, Erbium-doped fiber power-amplifiers, and higher sensitivity receivers.

The next section describes coherent detection and Erbium-doped fiber amplifiers. It also discusses optical switching technology that can be offered as an optional feature to the customer to provide end-to-end service on non-repeatered spans, with minimal interruptions.

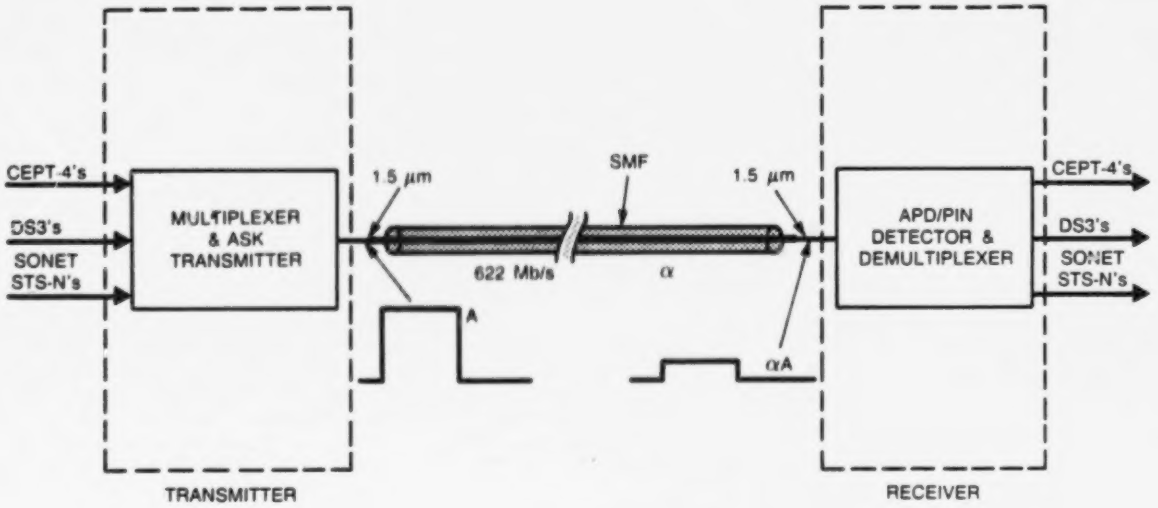
4.1 Coherent Detection

Most lightwave systems in the field today are direct detection on/off keyed systems. In this type of system (shown in Figure 1(a)), the intensity of the transmitter is modulated in an on/off fashion based on the data bit stream [1]. At the far end, the receiver detects either the presence or absence of a light pulse and converts the optical signal to an electrical signal. With selected high power transmitters and high sensitivity receivers, 1.5 µm direct detection systems are capable of performing adequately in applications up to 200 km [2].

Experimental sensitivity results for coherent detection have been better than direct detection [1,7]. A coherent FSK transmission system that features a FSK transmitter and a coherent receiver is shown in Figure 1(b) [3]. The transmitter output is used as a carrier that is frequency shift keyed by the data signal. This frequency shift keyed optical signal with amplitude 'A' is then coupled into optical fiber (with a loss α). At the detector, the optical signal with an amplitude 'αA' is optically added with a stable local laser source of amplitude 'B', where A, α and B are shown in the Figures. The square law nature of the detector produces a product component αAB, increasing the signal level compared to the direct detection case where only αA is received. This increases the signal to receiver noise ratio. At large input power levels, the noise level becomes proportional to the signal level. In coherent detection, B can be increased up to the point where αAB becomes large enough so that the noise level starts increasing in proportion to signal level. This differential received power level benefit represents the sensitivity increase of coherent detection compared to direct detection. This improvement in the receiver sensitivity can be used to increase the maximum attainable non-repeatered span length. Coherent FSK detection technique requires the use of narrow linewidth laser sources at the transmitter and as a local oscillator at the receiver, to improve the performance. It also keeps the effects of dispersion at a lower level over longer spans. However, the transmitter and local oscillator source wavelengths must be matched within a few tenths of a nanometer.

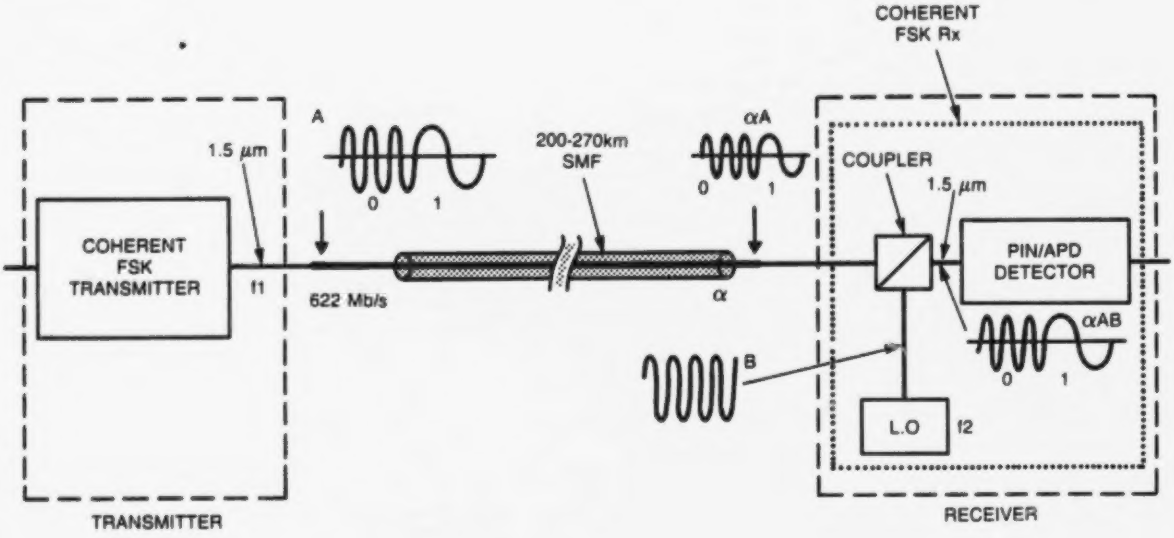
4.2 Erbium-Doped Fiber Amplifier (EDFA)

An EDFA is a Erbium-doped fiber charged into an excited state by a constant laser pump source [4]. Optical amplification is achieved as a result of stimulated emission by collisions of the incoming signal photons with the excited erbium ions in the fiber amplifier. EDFA's are attractive because of their high gain [4,5], low coupling loss to the transmission fiber, and insensitivity to input signal polarization in the


CEPT-4's
DS3's
SONET STS-N's
MULTIPLEXER & ASK TRANSMITTER
1.5 μm
SMF
1.5 μm
622 Mb/s
α
A
αA
APD/PIN DETECTOR & DEMULTIPLEXER
CEPT-4's
DS3's
SONET STS-N's
TRANSMITTER
RECEIVER

SMF ---→ CABLE WITH 6 PAIRS OF SINGLE MODE FIBER

FIGURE 1(a) DIRECT DETECTION SYSTEM


COHERENT FSK Rx
COHERENT FSK TRANSMITTER
1.5 μm
f1
A
0
1
622 Mb/s
200-270km SMF
αA
0
1
α
COUPLER
1.5 μm
PIN/APD DETECTOR
αAB
0
1
B
L.O
f2
TRANSMITTER
RECEIVER

L.O ---→ LOCAL OSCILLATOR LASER

FIGURE 1(b) COHERENT FSK SYSTEM

1.5 μm wavelength region. EDFA's can be used in undersea non-repeatered systems as power-amplifiers in transmitters and as pre-amplifiers in receivers to provide additional system gain.

Figure 2 shows a EDFA based system where a power-amplifier is used on the transmitter side and a pre-amplifier is used on the receiver side [5]. EDFAs are independent of bit rate and line format, thus enabling the power and pre-amplifiers to be used with various terminals. Implementing an EDFA based system may require a low chirp laser or an external electro-optic modulator, for an Amplitude Shifted Keyed (ASK) system with span lengths over 200 km to avoid dispersion problems. A narrowband optical filter is needed at the receiver to eliminate spontaneous emission noise.

Other issues related to EDFAs are laser pump wavelength band, high power pump lasers, narrowband optical filters, spectral response, and spontaneous emission noise. These issues are still being addressed [6,7].

4.3 Coherent Detection With Optical Fiber Amplifier

Coherent detection can be combined with EDFAs [7] to provide overall system gain of more than 50 dB at 622 Mb/s. With this amount of system gain and a cable loss of 0.18 dB/km, the achievable non-repeatered span length could be extended to nearly 300 km.

A coherent FSK system with an EDFA is shown in Figure 3. Since the fiber power-amplifier provides additional gain, the coherent FSK transmitter can have a lower power laser than that in the coherent detection system shown in Figure 1(b). Note that the fiber power-amplifier output power is limited by saturation. This configuration may provide an additional gain of 3 to 5 dB compared to the maximum gain provided by the coherent detection system shown in Figure 1(b).

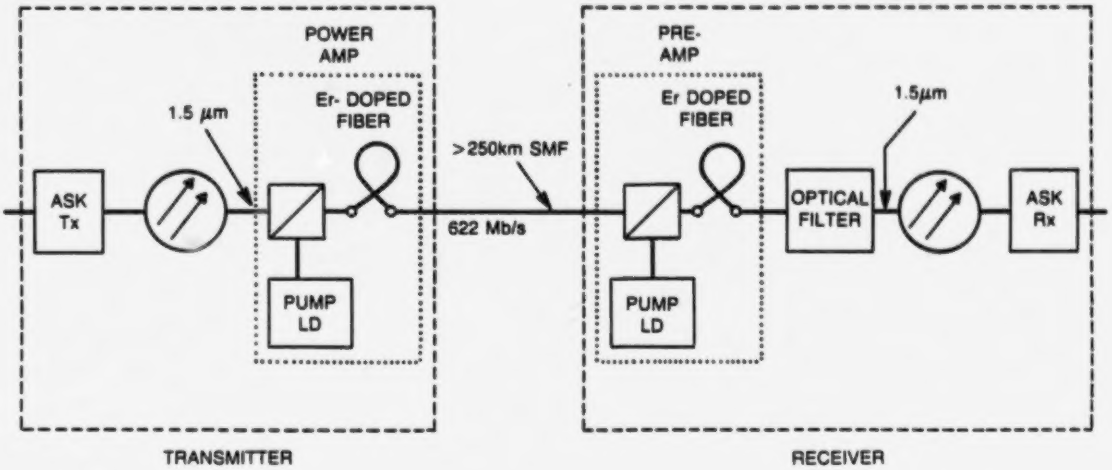

POWER AMP
Er- DOPED FIBER
1.5 μm
ASK Tx
PUMP LD
>250km SMF
622 Mb/s
PRE-AMP
Er DOPED FIBER
1.5μm
OPTICAL FILTER
ASK Rx
PUMP LD
TRANSMITTER
RECEIVER

FIGURE 2 ERBIUM DOPED FIBER AMPLIFIER (EDFA) SYSTEM

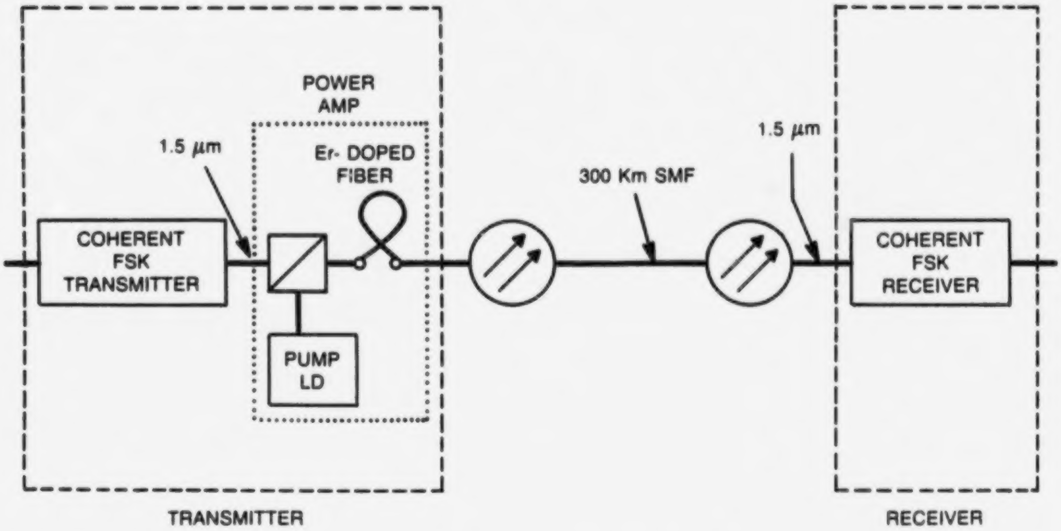

POWER AMP
1.5 μm
Er- DOPED FIBER
COHERENT FSK TRANSMITTER
PUMP LD
300 Km SMF
1.5 μm
COHERENT FSK RECEIVER
TRANSMITTER
RECEIVER

FIGURE 3 COHERENT FSK/EDFA SYSTEM

4.4 Optical Equipment Protection Switching

To provide end-to-end service with minimal interruption, terminal equipment will need to be protected. Optical switching, with electrical switching of terminal low speed inputs/outputs, can be offered as an optional feature to provide this capability. The advantage of the equipment protection switching is that it will provide end-to-end services with minimal interruptions, without requiring a fiber pair to be dedicated for protection. It provides protection against failure of optical components by using backup optical sources. Equipment protection can be provided on 1X1 basis, (i.e., one protection terminal dedicated for each service line terminal), or on 1XN basis, (i.e., protection terminal shared by N service line terminals). These options are described below.

Figure 4 shows the configuration where one protection terminal is dedicated to each or service terminal. In the conventional protection switching arrangement [1], the protection terminal is continuously monitored by the far end terminal using an additional fiber pair. In Figure 4, a fiber pair for protection is not required and the protection terminal is monitored for its health using its own receiver through an 2X2 optical switch and an optical attenuator [2]. If the service terminal fails, all input traffic is switched to the protection terminal input that transmits to the same line by changing the state of the 2X2 optical switch connected to the service terminal. The 2X2 optical switch connected to the protection terminal is also switched so that it receives the incoming traffic from the far end terminal. Thus, the roles of service and protection terminals are interchanged.

1 x 1 EQUIPMENT PROTECTION SWITCHING

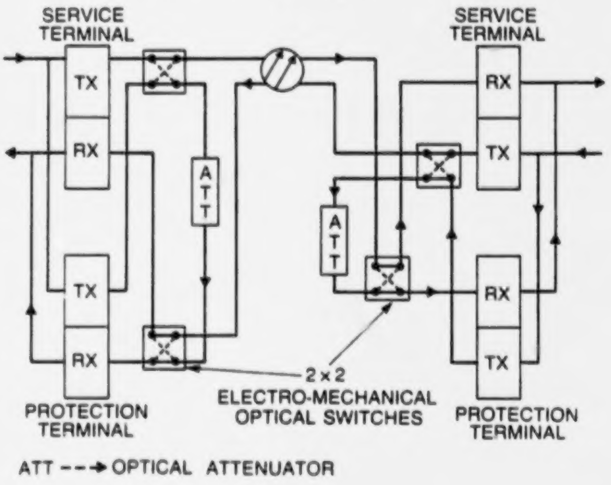


FIGURE 4

In this paper, the 1X1 equipment protection switching described above is extended to 1XN. Figure 5 shows one protection terminal shared by N service terminals through a 1XN optical switch. The operation of this configuration is similar to the 1X1 configuration except that only one service terminal can be protected at any given time. But, for an 1XN system with N > 1, the 1XN protection switching arrangement requires only one protection terminal thereby decreasing the terminal cost substantially compared to the 1X1 protection switching arrangement which requires N protection terminals, to protect N service terminals. The 2X2 and 1XN switches can be of the electro-mechanical type that are available in the market today.

Switch insertion loss is a major issue in these applications. Typical loss in a 2X2 electro-mechanical optical switch is about 0.8 dB and the switching time is about 10 msec. A 1XN optical switch with a switching time of 10 msec can be built from 1X2 (or 2X2) switches using '$\log_2 N$' stages. For N = 6, the 1X6 switch can be built using 3 stages of 1X2 switches. The optical loss of this switch will be equal to 2.4 dB. These losses do not include the additional connector losses. An additional optical connector per switch is required to connect the optical switch to the terminal. Each optical connector has a loss of about 0.5 dB.

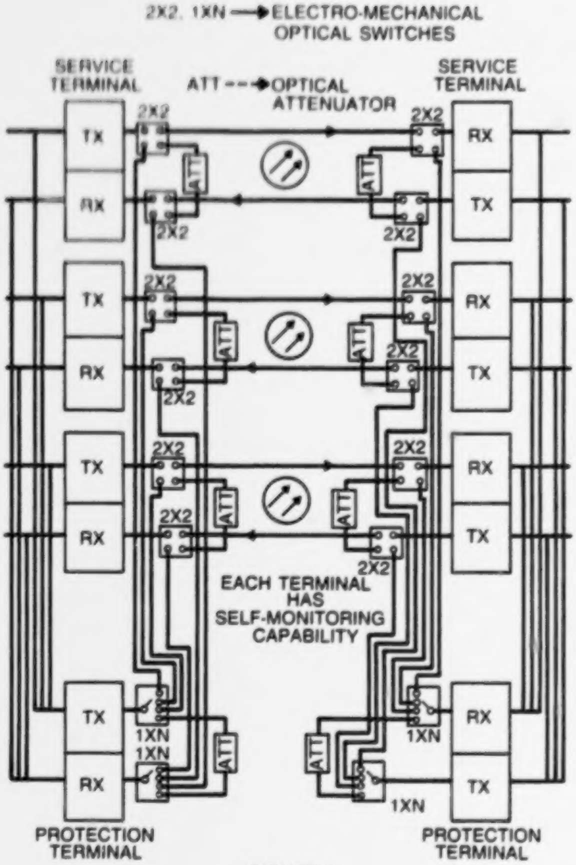

2X2, 1XN →ELECTRO-MECHANICAL OPTICAL SWITCHES
SERVICE TERMINAL
ATT --→OPTICAL ATTENUATOR
SERVICE TERMINAL
TX
RX
2X2
ATT
RX
TX
EACH TERMINAL HAS SELF-MONITORING CAPABILITY
1XN
PROTECTION TERMINAL
PROTECTION TERMINAL

FIGURE 5

1XN EQUIPMENT PROTECTION SWITCHING

5. SYSTEM ISSUES

As non-repeatered span lengths exceed 200 km, dispersion becomes a greater system concern. FSK modulation with coherent detection may allow up to 300 km span lengths at 622 Mb/s with conventional non-dispersion shifted fiber. The required narrow linewidth transmitter needed for coherent detection also keeps dispersion effects to a minimum.

An EDFA system (implemented with ASK modulation scheme) with power and pre-amplifiers will require narrow linewidth and low chirp laser, or external electro-optic modulator, to reduce dispersion effects with conventional non-dispersion shifted single mode fiber. An EDFA system can also be implemented with dispersion shifted fiber, which would relax transmitter requirements. Since dispersion shifted fiber has higher loss than non-dispersion shifted fiber, the dispersion shifted option would require additional gain to achieve the comparable span lengths obtained from conventional single-mode fiber option.

6. CONCLUSIONS

This paper has presented new lightwave technologies that may allow future non-repeatered systems to achieve longer span lengths. With FSK high powered transmitters, coherent detection and/or Erbium doped fiber amplifiers, non-repeatered systems can have a system gain of more than 50 dB at 622 Mb/s. With such a system gain, non-repeatered span lengths of nearly 300 km are achievable with 0.18 dB/km cable. With optical switching technology, end-to-end transmission of services can be made with minimal interruptions, when the terminal equipment fails, without requiring the use of an additional fiber pair.

7. ACKNOWLEDGEMENTS

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Session 3.4

Broadband

NOTES

TELEVISION SCRAMBLING AND ENCRYPTION

R. Ian Goodwin
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1. ABSTRACT

Understanding the important distinction between scrambling and encryption and the fundamental need to achieve high obscurity, high transparency and security has lead to the present state of the art with MAC encryption systems, which are optimized for satellite delivery. An encryption system now exists for PAL using the techniques developed for MAC, and this has the merits of transportability through all broadcast media, including terrestrial transmission, while maintaining the fundamental high performance criteria of MAC. The concept of over the air addressing has been extended to allow multiple broadcaster access to individual decoders, avoiding the need for separate decoders for each service, and avoiding the need for centralized authorisation bureaux, where these are not economic or acceptable to broadcasters.

2. INTRODUCTION

For many years television engineers and technicians have worked hard to improve the image and sound quality of television. Many are now trying to obscure the signal. Encrypted television is coming of age.

3. SCRAMBLING OR ENCRYPTION

To the layman, there is little difference between the words *scrambling* and *encryption*, however the distinction has proved to be an expensive embarrassment to some pay television broadcasters whose decoders have been pirated in various ways.

3.1 SCRAMBLING

A scrambler modifies the way a television signal is modulated and transmitted such that a normal receiver cannot reproduce sensible pictures or sound from the scrambled signal. Inversion of the synchronizing pulses or inversion of the video luminance voltage are techniques used in early scramblers (and some present day systems). Once cracked by a pirate there is little that a programme provider can do to prevent the unauthorized reception of programme material, except to change the system.

3.2 ENCRYPTION

Encryption of television however is more sophisticated than simple scrambling. It combines a variable scrambling process with a data transmission which tells authorised decoders which of the various scrambling processes are being used at any time. The data is encrypted, the television signal is merely scrambled. Together the effect is encrypted television. To be successful this process must use a variable scrambling method which has no identifiable signal properties which would give any clues about which of the various scrambling versions are in use. The decoder is then dependent on the data channel to correctly descramble the signal, and digital data is able to be securely encrypted by methods which are highly evolved.

4. USERS OF TELEVISION ENCRYPTION

Who would want to encrypt television? There are two main groups of users of television encryption: broadcasting, and security. Broadcasters use encryption for:

- pay tv
- narrowcasting (transmission to a closed user group)
- contribution circuits (programme exchange between studios).

Security applications for encryption include:

- industry
- police
- military/national security.

5. PSYCHOLOGY OF PIRACY

Why would anyone want to go to the trouble of trying to eavesdrop on encrypted television?

- personal desire to watch the programme
- compulsive hacker, or puzzle solver
- to sell pirate decoders for profit.

It is interesting to look at the psychology of the pirate decoder maker. Often the pirate decoder may cost more to make than the genuine decoder. What profit is there in it for the pirate in such cases?

The subscription to a pay tv service is made up of a number of component costs:

a) cost of buying or making the programme
b) cost of running the network studios
c) cost of transmitting
d) profit for the broadcaster
e) cost of decoders

In contrast, the manufacturing cost of the pirate decoder may be a little more than item e), but the profit for the pirate need only be less than the sum of items a) to d) to still be attractive to some viewers. Clearly the pirate has the potential to earn a higher percentage profit than the broadcaster. (Legal costs not withstanding.)

6. SCRAMBLING REQUIREMENTS

Let us look at some of the requirements of scrambling for television encryption. Good scrambling of both audio and video is difficult to do. Inevitably there are compromises to be made. Selecting a scrambling method for a specific application must match three main variables.

- OBSCURITY
- TRANSPARENCY
- SECURITY

Each of these variables applies separately to the audio and video components. Obscurity is the degree to which the scrambled sound or picture is made unintelligible to the eavesdropper. Transparency relates to the ability of the scrambling and descrambling processes combined, to deliver the sound and picture signals without impairment. Security is proportional to the resistance to unauthorised descrambling.

Each application has different requirements. For example a military system may need both high obscurity and high security at the expense of transparency. A pay tv system however may sacrifice obscurity of either audio or video (but not both) for high transparency and high security. There are systems available which rely on obscure audio because obscure video is hard to achieve, and invariably the transparency of the audio suffers. If a pay tv service is to use its decoders for narrowcasting (perhaps at night when normal transmission ceases) then both audio and video may need to be obscure if the material is sensitive, such as medical programmes to doctors, or business messages from head office to regional branch offices.

7. SCRAMBLING METHODS

Video scrambling methods have historically been difficult to achieve satisfactorily. Some of the analogue techniques have been:

- sync removal or sync inversion
- variable line start position
- picture polarity inversion either static, or at either line or field rate, and periodic or pseudo-random.

A number of scrambling systems working directly at RF have not been particularly successful. The interfering carrier invariably added to the transmission channel to defeat unauthorized viewers, is not difficult for a pirate to filter out.

8. PIRACY METHODS

In general, systems based on these analogue techniques have not been renowned for their security. Even if incorporated into an encryption system with secure data describing such information as where the line starts, which lines are inverted etc, the scrambled video signals invariably contain some telltale characteristic which allows a pirate decoder to bypass any need for decoding the encryption data channel. Typical telltale signs are a glitch at the start of each line showing when the active line begins, or a change in blanking level when a line is inverted. Sync removal does not deter modern television receivers with flywheel sync pulse circuits. They are able to trigger off the vertical blanking interval to produce reasonably stable pictures.

Decoder piracy can take several forms. As well as the method of ignoring the authorisation process altogether by looking for the telltale defects in the waveform to trigger the descrambling, the pirate may build clones of one genuine decoder, all with the same subscriber key number. One subscription for the genuine decoder results in all the pirate decoders being enabled. Alternatively a genuine decoder may be "hot wired" if a design weakness allows a single "authorised" wire to be shorted, permanently authorising the decoder.

9. SOUND SCRAMBLING

Because it is recognized that for pay tv, both video and audio do not need to be obscure, systems have often relied on sound scrambling to make up for the weak video methods. Typical audio scrambling for pay tv has used simple audio frequency inversion, or frequency shifting. Low and high frequencies are interchanged in the audio spectrum, or in frequency shifting, the audio spectrum is moved up by a few kHz. Any analogue audio scrambling method is unlikely to be both obscure and transparent after decoding. The public has got used to the medium fidelity of the broadcast television system. Any reduction of audio quality at a time when CDs and Hi Fi Video are raising audio awareness will be hard to sell.

10. AND THEN CAME MAC

The analogue video scrambling techniques mentioned earlier have had to make compromises in obscurity, transparency, or security. The advent of consumer digital components operating at video frequencies has allowed digital video scrambling to be developed. MAC (Multiplexed Analogue Component) television developed for satellite broadcasting uses digital line stores for time-multiplexing the luminance and chrominance video components. These components are time-compressed one after the other on each tv line. In the MAC receiver each line is temporarily held in a digital one line memory to enable the components to be decompressed and reassembled to form a coherent line with concurrent luminance and chrominance. The availability of a one line memory in the receiver has enabled digital video scrambling to be used.

10.1 B MAC SCRAMBLING

In B MAC, the line blanking period (carrying a digital audio stream) is varied in duration in a pseudo-random way. This effectively alters the horizontal position of each line which breaks up the picture coherence for non authorised decoders. The obscurity of this system exceeds anything previously available.

10.2 D/D2 MAC SCRAMBLING

D and D2 MAC, the versions to be used in Europe for direct broadcast satellite starting this year, use a line cut and rotate method of scrambling. In this method the encoder selects a pseudo-random cut point in the active portion of the line and then interchanges the left and right portions for transmission. In the decoder the cut point is synthesized from an identical PRBS (Pseudo Random Binary Sequence) generator and the two portions of the received active line are interchanged to reconstruct the picture. D/D2 MAC also allows for scrambling based on two cut points.

The obscurity of D/D2 MAC scrambling is very thorough and the transparency of the process is excellent. Only line tilt could distort the scrambled MAC signal during transmission, and satellite transmission does not generally suffer from line tilt.

One potential weakness of the active line cut and rotate method which might have compromised the security, would have been the sharp discontinuity that could occur at the cut point where the left and right edges of the picture are butted together in the scrambled waveform. The discontinuity where these unrelated portions of the picture are brought together may have been used by pirates to find the cut point and so defeat the encryption process. Fortunately the encoder makes a digitally controlled crossfade between the two portions, effectively concealing the cut point.

10.3 MAC SOUND SCRAMBLING

All of the MAC systems carry audio as a digital signal in the line blanking interval. These are encrypted in the digital domain, in ways which ensure obscurity, transparency and security.

11. PUBLIC DOMAIN SCRAMBLING

In D and D2 MAC the encryption and scrambling system has to contend with the demanding requirement that without compromising security, the television receivers incorporating MAC decoders must be able to be manufactured by companies anywhere from components which must be freely available. It is the distinction between the *scrambling* process, the *encryption* process and the *authorisation* process that enables MAC to work securely while the scrambling method is public knowledge.

11.1 D/D2 MAC ENCRYPTION

The EBU have published the technical details of the line cut and rotate scrambling method. They have also made public the details of the encryption system, including PRBS generator which decides the position of the cut point. The security is achieved by the way each decoder must be addressed over the air, and loaded with an authorisation key which is combined with the individual unique serial number concealed in the customer's decoder. This individual number, called a distribution key, is logically combined with yet another transmitted authorisation key, (which is a function of the service, the subscriber group, and the current time). The control word which results from this logical combination is used to seed a 60 bit PRBS generator in the decoder which determines the position of the cut point.

Sixty bits does not seem much, it is contained in only eight bytes of memory, however the 60 bit generator repeats its sequence of cut points

roughly every
150 000 000 000 000 000 tv lines. (300 000 years!) Television hasn't been invented that long. Furthermore with MAC the sequence restarts at a new point every frame. The digital audio and data channel is encrypted by an even harder method involving two cascaded 60 bit PRBS generators. The age of the universe pales into insignificance against the time the scrambling sequence would take to repeat.

11.2 D/D2 MAC AUTHORISATION

In MAC the distinction between scrambling and encryption is taken a stage further. The authorisation system is left open. This is the protocol by which the authorisation keys for the conditional access are delivered and stored in the decoder for enabling the decryption and descrambling to work. The authorisation system can be a separate plug-in module. Various consortia have been proposing separate and competing authorisation systems. Among them are Eurocrypt, Euromac, Cryptomac and Eurocypher which is the joint venture of General Instruments and British Satellite Broadcasting.

12. TRANSPORTABILITY

MAC is designed and optimised specifically for satellite and cable television. The audio is carried within a high data rate packet which makes it unsuitable for terrestrial transmission because of its sensitivity to multipath propagation phenomena. Compared with MAC, conventional PAL television is highly portable, and able to be carried by all broadcast delivery methods.

12.1 ACTIVE LINE ROTATION IN PAL

Since MAC was published by the EBU, a PAL version of the active line rotation method has been developed and put on the market. This is Cryptovision which uses the digital video integrated circuits now available for modern televisions. It has virtually the same encryption system as D/D2 MAC and the same characteristics of: high obscurity, high transparency and high security, but it is compatible with PAL transmission systems, and is thus highly portable and is suitable for terrestrial and cable transmission. It can also be broadcast by satellite and by Multipoint Microwave Distribution Systems (MMDS). Cryptovision can be carried on analogue microwave links and 70 or 140 Mbit/second digital circuits, both microwave and fibre optic cable. This enables PAL to be Cryptovision encrypted at the input to a complex distribution system and remain encrypted all the way to the final user. Because of its high disparity of picture information from line to line however, Cryptovision cannot be satisfactorily carried by the currently available 34Mb/s digital microwave systems.

13. PROGRAMME ACCESS CONTROL

Programme access control in addressable decoders usually uses memory registers which map the authorisation status for each programme or programme tier. These registers are addressed and loaded by the broadcaster during over the air addressing. Some systems need to poll decoders regularly to keep them enabled, while other systems work on the principal that once authorised a decoder remains authorised until specifically de-authorised. The number of tiers available differs significantly from one system to another.

Although MAC is intended to be used by a large number of broadcasters, the Eurocypher authorisation system does not allow individual broadcasters to directly address their subscribers with their transmissions. Eurocypher proposes to operate a bureau for all broadcasters using Eurocypher for DBS in Europe. They will manage the database of all subscribers for all broadcasters, and deliver a data feed of authorisation messages to each broadcaster for all programme subscriptions including those for other broadcasters. This has the benefit of being able to change the authorisation status of any Eurocypher decoder regardless of which channel is being watched at any time. Broadcasters however must submit to having less control over their subscriber database and authorisation process.

14. MULTIPLE BROADCASTER ACCESS

Interestingly Cryptovision has the ability for multiple broadcasters to access the same decoders, but only for their own programme authorisation. This avoids the need for a central bureau, although where more economic, a bureau can be used. There are registers in each decoder to allow up to 32 broadcasters to independently access the authorisation/de-authorisation of individual decoders for their programmes and tiers. Other broadcasters cannot interfere with their programme authorisation status. Logical channels can be assigned to 4000 different broadcasters in different regions of the world. Multi-broadcaster access to decoders is a characteristic which will have obvious benefits to both broadcasters and subscribers.

Multi-broadcaster access is essential to prevent a proliferation of decoders in each household. In Europe one D/D2 MAC decoder will be able to be used for all (MAC) broadcasts, but at this stage there will be more than one plug-in authorisation module needed. With Cryptovision, multiple broadcaster access and over the air authorisation avoids the need for plug-in authorisation modules and avoids the physical distribution problems this would have created for the broadcaster.

15. THE FUTURE

Conditional access television got off to a checkered start mainly in the cable systems where reliance was placed on scrambling as distinct from encryption techniques. Now it is reaching a maturity where high security is attainable along with excellent signal characteristics. The future must see an evolution to encryption systems available to multiple broadcasters using compatible or shared authorisation systems without mutual interference.

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Evolution of CATV Networks into Integrated Broadband Networks

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Cable television (CATV) companies in the United States have not recently been seen as providers of integrated broadband transport services. But a changing regulatory climate that may allow a good deal of head-to-head competition between CATV, telephone and possibly other companies for broadband services to the home. In fact, the U.S. CATV industry already has begun the process of rebuilding its networks in ways that will allow graceful migration into switched services of many types, should the market emerge and regulatory regimes allow such lines of business. This paper will discuss the changes and note their importance as possible precursors of an evolution from video entertainment to broadband integrated service networks.

Introduction

Cable television (CATV) companies in the United States have not recently been seen as providers of integrated broadband transport services, although there was much talk of CATV's role as an "information highway" into homes during the middle-1970s. And while it is popularly believed that the CATV industry has not had much interest in non-entertainment services including videotext, local loop bypass services, meter reading, home security, interactive opinion polling and other two-way services, in fact the industry has experimented with all these services but has found either a lack of genuine consumer demand or overwhelming resistence from telephone companies to pursuing such services.[1]

But there is good reason to believe that a changing regulatory climate that may allow a good deal of head-to-head competition between CATV, telephone and possibly other companies for broadband services to the home.[2] Under such conditions, the CATV industry may change its mind about the types of services it provides to customers.[3] In fact, CATV companies already start with a major advantage: They already have installed broadband facilities that pass over 90% of U.S. homes and provide service to well over 54% of those homes.[4] Futhermore, the industry expects that by 1995 it will have achieved penetration--based on video entertainment services alone--of 70 percent or better.[5]

Although traditionally a provider of one-way video services, the U.S. CATV industry already has begun the process of rebuilding its networks in ways that will allow graceful migration into switched services of many types, should the market emerge and regulatory regimes allow such lines of business.[6]

A key element of this new strategy is rapid migration towards hybrid networks that combine optical fiber technology with conventional radio frequency technology in ways that maximize the technical and business advantages of each.[7] Much as the U.S. telephone network introduced optical fiber first on the longest routes and gradually brought lightwave technology closer to the local loop, so CATV operators are introducing lightwave first on the backbone portions of their networks. At the same time, CATV operators are finding ways to integrate lightwave technology in a way that dramatically boosts the technical and business value of the existing coaxial cable already in place, increasing the bandwidth available to homes from the previous ceiling of 550 MHz (80 TV channels) to 1000 MHz (120 channels).[8]

At the same time, CATV companies are introducing numerous improvements in network technology that--while aimed at improving picture quality--also have the net effect of improving network reliability and robustness.[9]

And because it never has been a regulated "rate-of-return" industry run on utility models, CATV operators instinctively deploy cost-effective technology on a "pay-as-you-go" basis, deploying new technology only as revenues to support those investments emerge.[10] Unlike some other potential broadband competitors, CATV:

- already has current broadband services revenue streams
- already has broadband capacity to the home
- can increase bandwidth to 1000 MHz at low cost
- could put fiber close to the home at relatively low cost[11]

The industry also is on the verge of installing, for the first time, a universally-addressable model of service that is capable of citywide communications with all residences, not just with subscribers.[12] While initially designed to provide financial paybacks in the form of increased video service revenues and decreased operating expenses, the new service model also makes far easier the provision of telemetry and services on a scale previously unimaginable.[13]

New architectures

More important, though, are the dramatic changes in network design--or architecture--that accompany these other important developments.[14] Taken as a whole, these developments position the CATV industry for a remarkably flexible response to the developing integrated broadband services market, and suggest that CATV networks may prove to be cost-effective competitors for broadband services of many kinds.[15]

The CATV "tree-and-branch" architecture is marvelously efficient for delivery of one-way services, much as power and water systems similarly are optimized for one-way service.[16] But they have

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been criticized as having severe limitations in a two-way environment required major message switching. As a traditional telephone network is optimized for duplex communications, a traditional CATV network is optimized for simplex communications.

But many technologists in CATV believe that the existing tree-and-branch networks can evolve towards more sophisticated topologies--while retaining their basic form--in a way that matches the likely growth of consumer markets requiring greater degrees of signal switching.[17]

Furthermore, new thinking within the industry even suggests that novel methods may be used for integrating video, voice and data services for residential customers even while the networks that deliver the services are separate.[18]

New network flexibility

A number of intellectual currents and market forces now are converging to push the CATV industry rapidly towards installation of more efficient and flexible networks.[19] Among them:

- expected heightened competition for traditional video businesses
- more valuable services provided to customers and a need to secure them
- a heightened need for network signal performance to carry HDTV
- dramatically lower costs for lightwave gear optimized for video
- new demands for heightened responsiveness to in-home terminal gear[20]
- possible need to provide on-demand video services[21]
- possible need to compete in new lines of business

Cable industry leaders now expect that the future holds more competition for video entertainment customers. Such competition likely will come from direct broadcast by satellite (DBS), videocassette recorder tape rentals, direct overbuilds of cable systems by other cable operators, telephone companies and possibly other competitors that don't yet exist.[22] To meet the challenge of new competition, CATV operators feel they must improve the quality of customer service and pictures as well as reliability of their network.

And while traditional RF amplifier technology is hardly obsolete, the need to run long, serially-linked "cascades" of these devices necessary limits the number of channels that can be carried, the quality of the signals and distance these signals can be transported.[23] With current amplifier cascades typically running 35 or more devices in series, it is difficult to load more than 80 channels on a conventional CATV system and still maintain adequate system reach (distance covered) and signal quality. But if those cascades were limited to much shorter cascades of only four to seven devices, RF amplifiers could operate up to 1000 MHz.

Fiber optics is seen as the to reducing CATV amplifier cascades far enough that RF bandwidths can climb to 1 GHz, better matching the bandwidths offered by lightwave technology. And while nobody can yet predict what high definition television formats might ultimately become commercially successful in North America, it's a fair bet that at least some of the HDTV formats will require wider bandwidths than the current 6 MHz required for standard National Television Systems Committee (NTSC) pictures.

A not-insignificant development is the availability of new AM-optimized lasers and receivers that allow deployment of fiber optic technology at costs as low as $30 a subscriber above the cost of a conventional coaxial cable system rebuild.[24] In some cases, the cost to incorporate fiber optics may even be lower than a conventional build.[25] Equally important is the ability to pay for the costs of fiber introduction on an incremental basis, to serve existing customers.

Fiber's role

CATV operators traditionally have used FM fiber optic systems for "supertrunking" signals between headends and hubs since the late 1970s but the cost and complexity (AM signals must be converted to FM format for transportation and then must be reconverted back to AM format, requiring the use of air-conditioned buildings and equipment racks) have tended to limit the number of applications for fiber optics in CATV. The most common uses have included:

- High-quality earth station to headend links
- Headend interconnects (to share the costs of satellite-receive equipment among several headends or create regional advertising interconnects)
- Head-hub links to transport signals to "mini" headends in a single metropolitan area or to traverse hilly terrain in rural areas where microwave transportation isn't an option

A contributing--if sometimes unnoticed--element in new CATV thinking on fiber optics is the steadily increasing ability of advanced consumer electronics products, especially TV receivers, to display picture artifacts that previously were not perceptible to the untrained eye. There was no compelling reason to search for transmission technology capable of delivering pictures of higher quality when receivers could not display the better pictures. But many CATV operators, especially those serving large metropolitan areas with strong local broadcast signals, already have found it necessary to build their networks to deliver pictures of 46 decibels signal-to-noise ratio (about the same as "Super-VHS" VCR pictures) to the last subscriber at the end of the longest distribution cable. The previous industry standard had been 43 dB S/N.[26] The difference of 3 dB represents a 50 percent increase in S/N performance and fiber optics is seen as a key tool in boosting S/N performance.

Few CATV operators have yet to reach firm conclusions about the viability of "on-demand" programming as a viable revenue stream, although the popularity of rented videocassettes suggests the market has potential. On the other hand, the "pay-per-view" (PPV) movie and event business has been viewed somewhat skeptically by many CATV operators. Tele-Communications Inc., the nation's largest U.S. cable operator with more than 4.5 million subscribers in systems directly owned and managed, and interests in another 6.5 million or so, remains agnostic about PPV as a movie business, although it recently decided that events--sports and concerts in particular--are now a viable business.[27] On the other hand, a number of operators are quite bullish on the potential for PPV and are making plans to support multiple PPV channels on systems they own, with 11.5 million households equipped for PPV today.[28]

But whatever their positions on PPV's future, most observers tend to agree that today's networks should be designed in such a way that they can be upgraded to carry PPV or possibly forms of "on-demand" programming. The requisite flexibility can be built in primarily by ensuring that, as systems come up for their normal rebuild schedules (every seven to 15 years), they are positioned to carry higher bandwidths than may be needed in today's channel environment. Columbia International Inc., a middle-sized MSO ranked about 50 among the largest 100 multiple system operators, grappled with this issue at its engineering conference held in September 1989 and decided the most prudent course was to to design a network capable of handling 80 channels (550 MHz) even though 54 channels (440 MHz) probably was sufficient for the next five years or so.[29]

Perhaps furthest down the road is the possibility that full or significant competition for video, data and voice services may occur between some telephone and some CATV companies. To date, only Canadian-based Rogers Cablesystems has announced plans to enter the long-distance and cellular telephone markets. But many CATV operators privately take the position that the industry must be prepared for such competition in the event telephone companies gain the right to compete for CATV customers.

To prepare for the possibility that existing networks might have to carry traffic with different demand characteristics than CATV, industry engineers are looking at ways to use fiber optics to improve the existing video business while adding requisite flexibility to upgrade later for traffic that is more fully duplex. Fiber optics also seems to be a way to build needed flexibility into existing networks.

Traditional CATV network design

Traditional CATV networks have "tree-and-branch" (T/B) topologies that are designed to efficiently move signals on a point-to-multipoint (broadcast) basis. Like over-the-air broadcasting, water and electrical power systems, T/B architectures are most efficient when a uniform product is delivered to many distributed users. While switched-star architectures used by telephone companies are far more efficient for providing "any-to-any" communications requiring the establishment of direct circuit connections between any two users, T/B is the most efficient way to deliver multiple channels of broadcast type video and will probably prove to be the most cost-effective architecture for delivery of "pay-per-view" or other types of "on-demand" video, especially if the market for such services ultimately proves to be "blockbuster" movies and "event" programming.

Current state-of-the-art cable TV systems using conventional coaxial cable technology can be designed and built to deliver 80 6-MHz TV channels (550 MHz of bandwidth total) for a cost of about $600 a subscriber, including all outdoor plant and construction costs.[30]

Coaxial cable and radio frequency (RF) electronics are well-understood technologies with highly-standardized specifications supplied by a number of vendors whose competition keeps prices competitive.[31] While the current generation of amplifiers can support 550 MHz (77 to 80 channels) of bandwidth, the industry expects to develop newer devices capable of supporting bandwidths from 750 to 1,000 MHz sometime during the next two years.[32]

But CATV networks do suffer from some important limitations, most notably caused by the relatively high signal attenuation properties of coaxial cable and the non-linear signal reproducing capabilities of RF amplifiers operated in series (cascades) to combat the attenuation-inducing properties of coaxial cable. Furthermore, coaxial cable attenuates signals differentially. Signals at higher frequencies are attenuated more than signals carried at lower frequencies.[33] As CATV bandwidth has expanded from three channels(in the 1950s) to 12 channels (in the 1960s) to 35 channels (in the 1970s) to the current 77 to 80 channels, CATV operators have had to work harder at repeating the increasingly "lossy" signals at the upper reaches of the transmitted frequency spectrum.[34]

The result is a bandwidth limitation of about 550 MHz for today's CATV systems, even though the cable itself clearly can carry as much as 1,000 MHz. At frequencies above 550 MHz, attenuation increases so rapidly that cascades of 10 and greater devices simply are impractical. Not only is the signal degradation too great, but amplifiers must be spaced closer and closer together.

Unfortunately, signal gain cannot be applied indiscriminately, any more than the volume on a home stereo can be turned up to maximum without risking distortion (unwanted degradation) of the signals. CATV networks therefore must be designed around a window of operating tolerance that balances noise performance against distortion performance. Too little gain and the resulting signals are too weak. A TV picture looks "snowy." Too much gain and the signals are impaired--signals from two or more channels interfere with the desired channel.[35]

So long as the total number of RF amplifiers operated in series is not too large (30 to 40 is about the practical limit),[36] signals can be carried distances of about 12 miles before the distortion and noise parameters converge and require termination of the line.[37] But relatively high attenuation and the signal-impairing effects of amplifiers used to combat attenuation are not the only drawbacks coaxial cable has. Since the amplifiers are operated in series, each is dependent on the correct performance of the device in front of it. Should amplifier 16 be knocked out of action, amplifiers 17, 18, 19 and so forth also are knocked out. This of course means that device outages can ripple through the system.

Long cascades of amplifiers therefore are responsible for a number of system limitations:

- bandwidth restrictions
- signal quality impairments
- system reach limits
- network reliability shortcomings

CATV Network Redesign

In response to these perceived limitations, availability of new technologies such as fiber optics and the growing expectation of further competition in video markets, CATV operators have been discussing new architectures that would eliminate these problems. Fiber optics, a key tool in this regard, has been talked about and used on a limited basis in the cable TV industry since the early 1970s and was tried on a "fiber to the home" basis in the early 1980s in Alameda County, Calif.[38] Like other network operators such as telephone companies, CATV technologists have looked at optical fiber cost issues and discovered that the most obvious financial payback occurs when fiber is deployed first on the backbone routes, which spreads the cost of optoelectronics over the widest number of subscribers or customers.

In cable TV, that has meant deploying fiber optics first as a "supertrunking" medium to link earth stations and headends, headends with other headends or hubs. But CATV also is beginning to deploy lightwave technology further into the distribution network to:

- slice amplifier cascades
- improve network signal-to-noise performance
- create redundant signal paths
- build a technical base to expand bandwidth
- create new marketing possibilities

A key impetus for such deployment has been the development since late 1987 of AM fiber optic technology capable of carrying 20 to 60 channels of standard video in a format that is easily compatible with the existing base of RF gear used by CATV companies. At least 400 AM systems have been ordered since they first became commercially available during the fall of 1988 and the pace of introductions is expected to develop almost exponentially over the next five years as effective prices drop and more operators get experience with the new technology. Today, a number of operators are using fiber to slice the longest amplifier cascades[39] from 35 or more to 20 or less. Others, taking a more aggressive approach, are using fiber to break a single large cable TV system up into neighborhood-sized units of several hundred to several thousand homes.[40]

It's important to note here that CATV operators are overlaying fiber trunking on the existing coaxial cable network and plan to retain the use of coaxial cable drop cables to subscriber homes for the indefinite future. They also will continue to use coaxial cable for substantial portions of the trunk and feeder network as well. The reasons are fairly simple. Unlike telephone companies, whose networks are bandwidth limited in the local loop by twisted-pair copper, CATV companies are bandwidth limited in the trunking network.

Telcos must install fiber optics fairly close to the home to provide broadband services. CATV operators already have broadband capability to the home but tend to be bandwidth limited by the performance of the trunk portions of the network, the performance of which is constrained by the performance of RF amplifiers to about 550 MHz currently. Existing coaxial cable drops, by way of contrast, can easily handle 1 GHz (120 TV channels). So a key element in cable industry thinking is to maximize the performance of the already-existing broadband plant while eliminating the bandwidth limitations inherent in the conventional trunk portion of the network.

This can be accomplished by replacing significant portions of the coaxial cable trunking network with fiber optics. This has the subjective effect of moving a headend out into the network and closer to subscribers at system extremities. Such an approach also minimizes the capital cost by spreading the costs of optoelectronics over a wide subscriber base and conserving on fiber mileage as well. Cable industry estimates of the cost of installing "fiber backbone" capacity vary, but if fiber introduction is timed to coincide with a scheduled system upgrade—which requires a rebuild of the network—the cost per subscriber can range from $30 to $130.[41] A fiber backbone might use lightwave technology to move signals from headends deep into the network, converting signals from light back to radio frequency format and running them through four to seven conventional RF trunk amplifiers and two line extenders before delivering them to the customer premises. Over a period of time, industry technologists predict that lightwave might gradually find its way out to bridger amplifer locations or taps. The bridger amplifier (an RF device) would feed a very short line extender cascade of two amps. Running optical signals to a tap location would put the optical-to-RF conversion point at a curbside location.

CATV companies will find it economically feasible to deploy fiber in such a manner in all service areas, not just new housing construction areas, because of the relatively frequent rebuild cycles for CATV plant. As a rule, CATV plant is completely rebuilt about every seven to 15 years, not necessarily because the cable is unusable but because bandwidth demands have grown so much that lower-loss cable and higher-capacity amplifiers must be installed. When such system rebuilds are driven by channel capacity upgrades (from the 1970s standard of 35 channels to the 1990 standard of 80 channels), cable operators already are finding that integrating fiber optics into the plant can actually reduce plant construction costs compared to a conventional all-coax design.[42]

CATV networks increasingly will be redesigned over the next five to 10 years to meet new business objectives and will use fiber optics in conjunction with coaxial cable and new amplifier technologies to:

- Increase bandwidth from 550 to 1,000 MHz
- Improve signal quality
- Increase network reliability
- Slice amplifier cascades
- Create a new "cellular" network

Key CATV Models

Several key architectural models now serve as starting points for CATV operators integrating lightwave technology into their networks. Although each of the key models share common fundamental assumptions, each takes a different route to achieving network redundancy and reliability. Key models include the:

- American Television & Communications "Fiber backbone"
- The Rogers Cablesystems "Fiber Architecture"
- The Jones Intercable "Cable Area Network"

Each architecture uses lightwave technology to shorten amplifier cascades and physically or logically break a single metropolitan-sized network into many smaller sub-networks. Each provides new signal path redundancy features as well.

The pioneering ATC "Fiber backbone" initially was proposed industrywide in 1988. While addressing the key limitation of T/B architecture--long cascades of amplifiers--the ATC topology also represents a blueprint for cost-effective network evolution to more fully interactive capabilities.

The ATC architecture breaks a single large CATV system up into a collection of smaller--and discrete--serving areas by feeding broadband signals from a headend to optical receive nodes serving a few hundred to a few thousand homes. Optical-to-electrical signal conversion occurs at the nodes and standard RF format signals are then distributed over traditional coaxial cable and short amplifier cascades of four amplifers.

The subjective effect of the ATC design is to move the headend closer to the customer, providing much better signal quality. The objective effect is to improve reliability by slashing the long amplifier cascades and also make possible the use of RF amplifiers with dramatically higher bandwidths from 750 to 1000 MHz, thereby creating vastly greater channel capacity.

ATC design engineers believe a fiber backbone system can be installed for a cost as low as $30 per subscriber over the cost of a conventional plant rebuild.[43] Equally important from a strategic perspective is the network flexibility the new design allows. Suppose that some form of on-demand programming emerges as a viable market and an early driver for broadband services to residential subscribers. To provide such services, a network operator would have to possess:

- Signal switching capability adequate to allow random customer access to a large programming menu
- Adequate program storage (videodiscs, VTRs) to allow multiple access to any given program at random start times
- Adequate channel capacity

The ATC model would allow creation of a "near video-on-demand" service by dedicating a relatively limited number of broadcast channels that would provide a limited menu of "blockbuster" hit movie or events with staggered start times. A customer would be able to access any event at 15-minute intervals, for example.

Distributed switches could be placed at each fiber receive node, improving network efficiency by limiting the total number of program requests that might be experienced because the total serving area is only a few hundred or few thousand homes. Such a deployment also reduces the complexity and cost of the required video switches.

Because program material would be supplied on a "broadcast" basis network-wide, but actually switched at a level roughly corresponding to a telco remote terminal or serving area interface, the number of program playback devices located at the headend also is reduced.

The ATC model also envisions creation of network redundancy by creating a ring structure linking the optical hubs. The result is a "wheel and spoke" configuration that provides at least two independent signal paths to any single hub location.

The Rogers model

The Rogers fiber architecture expands on this theme by constructing a dual ring backbone that links primary hubs serving 120,000 homes each and further connects secondary hubs serving a maximum of 8,000 homes in a second ring. The Rogers plan further places optical hub sites in a configuration that allows the hubs to function as transmission sites for cellular telephone services.[44]

In the Rogers design, the headend may be thought of as the equivalent of a toll office. The primary hub sites are seen as equivalents to telco central offices. The secondary hubs may be seen as equivalent to serving area interfaces. Rogers intends to further extend the optical network from the secondary hubs to optical bridger sites that serve 180 homes each. This third level of optical receive points corresponds, by design, to the telco remote terminal location. Four fibers will serve each optical bridger. Two fibers will provide downstream video signals while one fiber will provide upstream data and voice traffic, if desirable. The third fiber is reserved for on-demand, switched video.

The topology specifically incorporates enough channel capacity to carry 150 video channels, possibly 80 channels of broadcast services and 24 on-demand channels as well. More important, it creates a network that can be adapted to carry voice and data serviceson an "any-to-any" basis as well.

Rogers estimates the entire fiber network can be constructed for as little as $130 per subscriber, allowing cost-effective deployment of fiber close to the home and further positioning the network architecture for voice and data switching as well.

The Jones Intercable "Cable Area Network" uses a different architecture but achieves similer network flexibility and redundancy while creating local switch points. Unlike the ATC and Rogers designs, the CAN leaves the existing RF network in place as a "hot standby" and runs optical fiber from a headend out into the network, inserting signals into the RF net at about every seventh amplifier. Route diversity is ensured by running the optical fiber over physically separated paths. The fiber is not overlashed to the existing coaxial cable network.[45]

Intelligent A/B switches can detect failure of the primary optical path and will automatically switch to the backup path. Aside from protecting new measures of reliability for residential video customers, the extensive fiber network specifically incorporate enough extra dark fiber to offer business customers high-bandwidth communications within the CAN service area (generally a metropolitan area).

The CAN design also dramatically expands the performance of the traditional RF plant. Traditionally, RF plant has reserved only the 5 to 30 MHz band for return path communications. Because of the T/B network design all signals inbound from anywhere on the network will funnel back towards the headend. Traditionally, this has meant that all system noise and distortion also will funnel back towards the headend, creating severe noise loading problems.

But the CAN fiber nodes eliminate this problem. The potential noise can accumulate only over the short seven-amplifier coaxial path. All inbound signals funnel over a very short T/B network to an optical hub, which is then directly wired to the headend. That eliminates the problem of noise addition on the return path.

An equally important result is that the 5 to 30 MHz return bandwidth can be reused. Each optical node serves a smaller neighborhood-sized area and each node therefore has the 5 to 30 MHz return bandwidth available for use. Where an entire metropolitan area had only the 25 MHz return, now each subnetwork served by an optical node (seven amplifiers) has 25 MHz. So the total system return bandwidth is increased by the total number of nodes.

A 300-mile coaxial network that had 25 MHz return path capability would--after the CAN is put into place--have a total of 2150 MHz of return bandwidth. This is in addition to the return bandwidth provided by the optical paths.

A changing customer interface

More flexible network topologies and bandwidth, signal path redundancy and greater switching capability are only part of the story, however. A broadband network offering voice and data services must have the ability to address each household in a service area, something CATV networks have not traditionally been able to do. But the industry, driven by a variety of pressures, most notably the increasing tuning ability and features of in-home video equipment, is on the verge of migrating from its traditional non-addressable customer interface to a new type of interface that will provide universal addressing capability for all homes in a service area, whether or not those homes are current cable TV subscribers or not.

Although the moves are being instituted primarily to satisfy the growing demands video customers have for full and transparent control of all authorized signals delivered to their homes as well as to reduce operating costs, the new customer interface will also provide an opportunity to provide data or voice services should the opportunity and desire arise.

Recent moves by the two largest cable TV multiple system operators illustrate the trend. TCI, the nation's largest cable operator, recently announced plans to convert all of its subscribers to addressable control, a significant move that will accelerate industry moves to addressable control of home drops. TCI furthermore has said that henceforth it will wire all homes in a service area with drops, breaking with cable TV tradition and offering--for the first time--100 percent accessibility of network services to all customers in a service area.[46]

ATC, the nation's second largest operator, also has announced its interest in and support for such a customer interface that would wire all homes in a service area and provide remote addressable control of each of the drops.[47]

Although the specific control strategies are slightly different--TCI puts the network termination on the side of a house while ATC puts the network termination on a pole or in a pedestal--the objectives are the same. Both interfaces will terminate network services at a definable point and allow the customer to control the in-home wiring and customer premises equipment. Both models would allow service level changes in the same manner now used by telephone companies.

What is most important about these moves, however, is that they sharply accelerate the CATV industry's move towards installed addressing capability at each subscriber's home as well as at the homes of all non-subscribers within a service area. This will increase near-term revenue opportunities for traditional and on-demand video services as well as provide a platform for growth into other types of services, should they be deemed desirable and should the regulatory climate permit.

Whether signal switching and on-off channel control is located on a telephone pole, on the side of a customer's home, in the basement or inside the home is not so important as the fact that the remotely-controllable signal switching capability is in place and paid for out of current revenue streams.

Implications for integrated broadband networks

CATV operators may someday decide they must move beyond provision of entertainment video and become providers of other types of services as well. To prepare for this possibility, the cable TV industry now is positioning its networks for flexible migration to architectures that will cost-effectively provide video and other high-bandwidth services to residential subscribers.

A key element of this new strategy is rapid migration towards hybrid networks that combine optical fiber technology with conventional radio frequency technology. Much as the U.S. telephone network introduced optical fiber first on the longest routes and gradually brought lightwave technology closer to the local loop, so CATV operators are introducing lightwave first on the backbone portions of their networks. At the same time, CATV operators are finding ways to integrate lightwave technology in a way that dramatically boosts the technical and business value of the existing coaxial cable already in place, increasing the bandwidth available to homes from the previous ceiling of 550 MHz (80 TV channels) to 1000 MHz (120 channels).

These same developments--while aimed at improving entertainment network picture quality--also have the net effect of improving network reliability and robustness, making CATV a stronger contender for new types of digitally-based services that may develop as new consumer markets.

The CATV industry also is deploying such technology on a "pay-as-you-go" basis. Virtually all the network improvements will improve the quality and market position of the entertainment video business CATV already has, while simultaneously laying the foundation for services that require greater switching.

A new development in this regard is the industry's move to a universally-addressable model of service that is capable of citywide communications with all residences, not just with subscribers. While initially designed to provide financial paybacks in the form of increased video service revenues and decreased operating expenses, the new service model also makes far easier the provision of telemetry and services on a scale previously unimaginable.

The CATV industry's position in the residential market, supported by low capital and operating cost advantages, may also be enhanced by the asymmetrical nature of most envisioned broadband services, which require modest upstream capability--mostly for signaling--and high bandwidth downstream. It may ultimately prove to be the case that residential subscribers do develop a taste for on-demand video services, perhaps in an HDTV format. And it may prove to be correct that a digital signaling rate of 90 to 150 megabits is required to deliver these services to the home.

Perhaps residential subscribers will acquire a taste for new types of interactive digital services of some type and be willing to pay money to get them.

Do these possibilities necessarily imply that a fiber-to-the-home telephone network must be constructed to deliver such services? I believe the answer is "no." With the exception of two-way video, all other proposed broadband services require limited bandwith upstream. The real demands for bandwidth are in the downstream direction.

This may indicate that a flexible migration of current CATV network architecture--heavily based on downstream bandwidth--may be a convenient, low-cost way to deliver the requested services. A human can type on a keyboard no mfaster than 15 characters a second, which requires only a 120 bps transmission rate. That's clearly adequate for ordering commands to access a database, participate in a poll or enter a response to an interactive video or text program. If the means of response were by lightpen, perhaps 150 bps would be required.[48]

Despite the vast potential store of information in databases, a human can read only up to 250 characters a second, requiring the ability to transmit 2,000 bps. A residential customer making a plane reservation or checking stock quotations might require 10 bps signaling capability. That same customer ordering merchandise for a video catalog might require a 40 bps signaling rate.

The sending of a fire or burglar alarm would take about 40 bits in total while a library book order could take 200 bits. An electronic funds transfer might require about 500 bits; an interoffice memo about 3,000 bits.

The point here is simply that even if residential customers someday acquire an appetite for broadband services, it is by no means certain that an integrated network--especially an all-digital network--is the only way, or the most cost-effective way, to deliver them. In point of fact, almost all the bandwidth is required in the downstream direction. Even the medium-bandwidth applications, such as facsimile or still photo transmission, requires only about 200,000 bps.

An argument may eventually be made that it makes most sense, as an interim step, to use existing cable TV networks for downstream delivery and the telpehone network for upstream, integrating the services provided by the two networks in the home or on the side of the home by means of new customer premises equipment.

Cable TV networks, although not generally seen as viable candidates for delivering integrated services, may prove to be far more resilient and cost-effective than most observers have imagined to date.

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Session 3.5

Mobile Communication Perspectives

NOTES

WIRELESS COMMUNICATIONS FOR THE 1990'S

ELIMINATING THE BARRIERS TO USER MOBILITY

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INTRODUCTION

Advances in technology have revolutionized how we conduct our lives at home, on the road, and at work. Exiting the 1980's, we are poised at the brink of a new age, fostered by the increasing applicability of wireless connectivity to our daily activities. This paper addresses the numerous emerging applications of wireless communications from both a Personal and an Organizational communications standpoint. These new forms of communications will transform our culture, allowing users to escape the bonds of wire that prohibit or inhibit freedom of movement and interaction.

Before looking into the future, it is appropriate to review the major advancements in personal and organizational wireless communications that have evolved during the decade of the 1980s.

PERSONAL COMMUNICATIONS IN THE 1980s

The 1980's have seen a tremendous advance in the area of personal communications. One-way and two-way wireless personal communication devices are cutting the tether that prohibits mobility.

Subscriber Paging

Subscriber Paging has traditionally been a one-way message service, ranging from tone-only alerting to sophisticated alpha-numeric display messaging and voice storage facilities. Some examples are the national satellite paging service in over 50 U.S. cities for business travelers; the transportation industry multi-state paging service; and metropolitan area paging service for physicians.

Cordless Phones

Cordless "Patio Phones" have recently become popular, allowing freedom of movement in and around the home. This popularity is directly attributable to technical improvements made over the past three years. In the early 1980s, cordless phones were poorly designed. They suffered from low speech quality, interference, poor security (which allowed phone "pirates" to make unauthorized calls), and limited cordless phone spectrum. These problems, and the resultant bad press, eroded consumer confidence.

Now, with more channels, better security, and application of digital techniques, consumer adoption of cordless phones has dramatically increased. However, because of transmission capabilities that are typically limited to much less than the advertised "1000 feet," the domain of this class of wireless phone will continue to be centered in the home as an additional extension phone.

Cellular

Indisputably the greatest achievement in personal communications to date is "Cellular"; both in terms of the cellular phone itself, and the significant radio infrastructure that is being put in-place to allow for seamless total area coverage. Beginning as a luxury item, cellular has become a necessity for both personal and business use. The last three years have seen tremendous growth, as phone prices and weight continue to decline, and as people realize the significant convenience and productivity benefits that accrue from being in touch virtually anywhere.

ORGANIZATIONAL COMMUNICATIONS IN THE 1980s

Private Mobile/Portable Radio Services

Individually licensed, owned and operated, Private Mobile Radio services are primarily for internal dispatch communications. The 1980's saw the effective marriage of hand-held terminal screens and personal computer power with radio to allow companies like Federal Express and IBM to more expeditiously and effectively serve their customers.

Cellular, Private Radio, and Paging are predominantly metropolitan, wide area applications of wireless communications. One of the last frontiers, yet to be addressed in a significant manner by the application of wireless communications, is the domain of inside buildings. Since this application is so new, it warrants a more detailed discussion.

In-Building Communications Needs

In the 1980s we have seen the development of a significant range of in-building business communications problems that have been caused by the changes in the technological, business, and regulatory environments. Because of these developments, buyers of telecommunications and data communications systems increasingly are having to face the significant time, cost, and logistical problems associated with the installation, movement, and management of computing and communications equipment in dynamic office environments. A look at some of these developments may lend some perspective on the problems.
In the "early days", life was simpler. As an example, in the U.S., telephone companies used to provide business customers all voice wiring as part of their leasing arrangements for telephones. Building owners and occupants were not concerned with planning, installation, administration, and maintenance of their communication facilities. Data wiring was installed by the user's data processing vendor independent of the voice wiring.

Both divestiture and the FCC ruling detariffing all wiring as of January 1st, 1987 have created a completely new environment for U.S. commercial building wiring. Most users now own their own on-premises voice lines and are responsible for maintaining them. Coupled with these developments have been the proliferation of data terminals/PCs, the emergence of data Local Area Networks (LANs) and integrated voice/data PBXs, with both LANs and PBXs using each vendor's unique wiring systems. Beneath the surface of today's increasingly computerized offices lies a tangled maze of wiring. As a result, computer and communication technologies have created a "wiring nightmare" for network operators and building managers.

The costs of manipulating and managing these wiring media are significant. The life cycle costs from servicing existing cable and running new cable when new systems and/or users are added to a network can range from $200 per voice change, up to $1,000 per data change. Multiplying these per-subscriber costs times the frequency of moves adds and changes over time can result in costs that easily surpass the original purchase price of the communication system itself in two to three years.

WIRELESS COMMUNICATIONS FOR THE 1990s AND BEYOND

Organizational Communications

The numerous problems with wiring will become even more acute in the office of the 1990s. This environment will be characterized by:

- The proliferation and decentralization of computing power

- Increased number of telephones as an outgrowth of the economy's shift toward service industries.

As the penetration of Personal Computers (PCs) nears a one-to-one relationship with phones in the white collar workplace, the limitations of separate voice and data networks will become even more evident. If these problems are not addressed, an organization's flexibility in redeploying "people assets" will be seriously hindered. The time it takes to move/add/change voice and data communications equipment and reconfigure separate voice and data network communication wires will be the limiting factor in rapidly reorganizing workgroups and responding to new assignments.

Cellular Technology

A very attractive solution for addressing these problems is "Why not use 'cellular' inside buildings"? This question calls for a closer look at what cellular provides and how it is perceived today, and how that will evolve in the future.

The wide area coverage cellular service that we utilize today was not optimized for in-building use. The reasons for this are twofold. Number one, metal, brick walls, and metalized windows prevent outside radio signals from effectively reaching inside the building and providing sufficient coverage area. Secondly, the higher user densities as well as usage patterns of "fixed" voice and data communications call for much greater capacity than traditional mobile-oriented cellular provides.

However, the cellular technique itself, defined as partitioning the coverage area into lower-power cells in order to reuse valuable radio spectrum, is applicable by implementing much smaller, in-building radio systems called "Micro-cells".

Micro-Cells

Micro-cells are being designed to optimize system performance for much more defined and focused coverage areas, ranging from a department, a floor, an entire building, or a city block. Based on the the optimization of customers' requirements for coverage area and voice/data mix, combined with frequency availability, there will be a number of Micro-cellular system alternatives.

As an example, with the numerous problems of in-building voice/data communications wiring alluded to in this paper, a Micro-cellular system could be implemented to eliminate the "last 100 feet" of wiring to the subscribers' desks. Such a system would eliminate communications downtime and reduce the ongoing costs of moves, adds and changes.

Wireless Initiatives

There are a number of initiatives around the world that embrace micro-cell techniques to offer a measure of wireless connectivity at both a personal and organization level. "CT-2" is a U.K. based initiative which can be characterized as a "personal payphone". The CT-2 phone is designed to work with "Telepoints"; micro-cells that are situated in locations such as railway stations, airports, etc., and allow the user to place (not receive) telephone calls. The demand to date for these phones has been limited, as the four licensed network operators have yet to implement a non-proprietary Common Air Interface that allows phones of different manufacture to work on any operator's Telepoint. Such phones are not projected to be available until the middle of 1990.

Another U.K. initiative is "Personal Communications Network" or PCN. This is a more fully featured micro-cell system which will provide portable phone users with two way communications capability, initially outside of buildings but also allowing for portability within buildings. PCN service is targeted to begin in 1992.

A Pan-European initiative called "Digital European Cordless Telephone" or DECT has as its focus the provision of primarily in-building voice portables, with plans to add a one-megabit per second data communications capability at some point. DECT product introduction is unclear; estimates range from 1992 to 1995. In addition, some vendors are considering the introduction of "DECT-like" variants at lower frequency bands than current DECT specifications call for.

Wireless Local Area Networks will become an attractive solution in the office of the 1990s, interconnecting personal computers and offering data communications capabilities without need for elaborate cabling methodologies.

The wireless systems finding success will be those that most precisely meet the application requirements of a chosen customer segment. Some of the above-mentioned solutions may appear to be directly competitive with each other. However, a deeper look at the applications indicate that some of these systems may in fact be complementary solutions that offer targeted price/performance levels to different economic classes of customer.

CHALLENGE FOR THE 1990s

The recognition of the numerous benefits of wireless communications will result in even greater customer demand in the coming decade of the 1990s. Manufacturers are responding with a number of highly desirable product configurations, ranging from the "Personal Communicator" to wireless in-building networks for business organizations. In order to supply this expected demand, two major ingredients are required: Spectrum and Advanced Technology.

The lifeblood of wireless communications is spectrum. Governments are faced with difficult choices on who will be awarded spectrum, and how the "rules of the game" will be played. Manufacturers that are large enough can compete on a global basis, designing and manufacturing product tailored to each country's spectrum rules. Smaller companies must focus on individual countries to find success.

Technology is the lifeline that we utilize in striving toward more effective utilization of these scarce spectrum resources. An excellent example of a technology breakthrough is the cellular concept that has been discussed earlier in this paper.

Such frequency re-use approaches will continue to evolve with the implementation of Micro-cell systems. However, given projected wireless worldwide demand of at least 50 Million subscribers in the 1990s, new spectrum allocations will be required in order to keep pace with customer requirements.

Our collective challenge, as manufacturers, governments, and network providers, is to break down the remaining barriers to user mobility. Telecommunications has been widely recognized as an essential element in leading the industrialization process. Wireless telecommunications will lead the next wave, changing the very nature of how people interact with one another.

The Pan-European Digital Cellular System
Possibilities and Prospects for Extending its Standard outside Europe

Pacific Telecommunications Council, 12th Annual Conference,

January 14 - 17, 1990, Honolulu, Hawaii

Roland Mahler
Deutsche Bundespost Telekom
Bonn, Federal Republic of Germany

0. ABSTRACT

This paper describes the development of the Pan-European Digital Cellular System starting out from the current situation of mobile communication services in Europe. It illustrates the philosophy on which standardization of the system is based, its services, its facilities, the technology used and its advantages. Other standards that are being discussed and trends in the development of the third mobile radio generation are also presented. Finally, the question of how a Universal Mobile Telephone System could be implemented is raised.

1. INTRODUCTION

Today, telecommunications developments in all industrialized countries are focussed on mobile communication services. After having been neglected for a long time, they have become one of the most innovative areas in recent years.

The technological success achieved through mutual benefit in the miniaturization of electronic circuits, in digitalization and in microprocessor technology has opened up opportunities in mobile communications undreamt of only a few years ago.

The basic mobile radiotelephone has made a first evolutionary step; it has been enhanced by the possibilities of data transmission, at first "saddled" on voice and in the Pan-European digital system already integrated digitally. Radiopaging and trunked land mobile radio networks, radio PBXs and telepoints as well as mobile communications via satellite have been added to the mobile communications family.

2. THE PRESENT SITUATION OF MOBILE COMMUNICATIONS IN EUROPE

Today's most widely used mobile communication networks are based on genuine cellular systems whose intelligence permits to establish the whereabouts of the mobile communication subscriber at any given time. So the calling wired subscriber can reach the roaming mobile subscriber over a call number that is independent of the location. Another feature is the cell-to-cell handover of calls without any interruption.

The present situation of mobile communication services in Europe is characterized by each country acting on its own initiative not only as regards the type of system but also the approval procedures for terminal equipment and the regulations for taking terminal equipment abroad.

Europe represents a patchwork consisting of the different systems used in 19 countries.

More than 2 million subscribers throughout Europe are using these systems. The average penetration rate is well over 0.5 per cent. It differs widely in the individual European countries, the maximum penetration rate being 4 per cent in Norway, whereas in Germany it only amounts to 0.25 per cent, thus leaving much scope for improvement.

The European patchwork of systems (Figure 1) impedes the unhindered, free development of mobile communications in many respects:

- The radiotelephone terminal equipment market is split up into many small individual markets; as a result, prices only fall very slowly and thus reluctance on the part of the customers to subscribe to the service also diminishes only gradually.
- Particularly in a Europe which is moving towards a single market and in which transborder travelling is steadily increasing, the customer will not understand why his terminal can only be used in a few other countries or even in no other country at all.
- There is hardly any competition as far as the procurement of the network infrastructure is concerned, which gives some network operators reason for concern.
- Europe-wide joint marketing initiatives are impossible as there are marked differences owing to national peculiarities.

Public Mobile Radio Communication in Europe

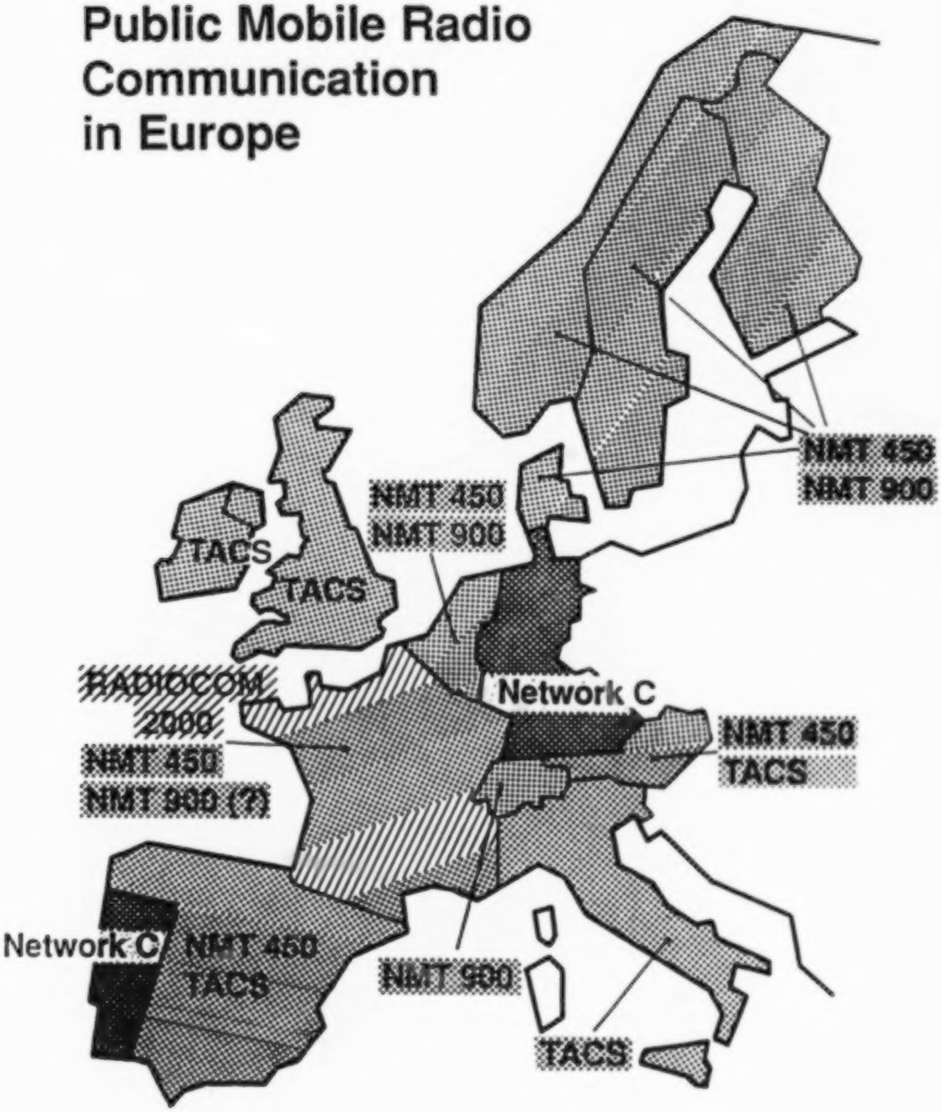

NMT 450
NMT 900
NMT 450
NMT 900
TACS
TACS
~~RADIOCOM 2000~~
NMT 450
NMT 900 (?)
Network C
NMT 450
TACS
Network C
NMT 450
TACS
NMT 900
TACS

Figure 1

3. THE PAN-EUROPEAN DIGITAL CELLULAR SYSTEM

3.1 GENERAL

To meet growing demand, endeavours to open up possibilities for the use of the 900 MHz range were already made in the early eighties. But only Germany and France, where this frequency range became available later than in other countries, grasped the opportunity to develop a border-crossing system. After a brief phase in which an analogue system was considered, the courageous move towards a digital system was made, whose risks could hardly be assessed by anyone at that time.

This bilateral Franco-German project was extended to include Italy in 1985, the UK in 1986 and culminated in 1987 in a Memorandum of Understanding which provides for the joint operation of a Europe-wide cellular digital mobile communication network to be started in 1991. Surprisingly, as many as 13 European countries acceded to the Memorandum at that time. Today, 18 countries with 20 operating agencies have signed it.

The fact that so many countries set their own ideas and interests aside and committed themselves to the development and introduction of a common standard certainly was an important event in the development of telecommunications. Meanwhile the CEPT, now ETSI Group GSM (1) has completed in a huge effort nearly all of the specifications; the phase of validation is under way, the phase of consolidation will follow. Those who viewed the whole undertaking with scepticism at first, either because they thought the Western European countries could never agree on a common standard or because they doubted the feasibility of digital transmission, had to revise their opinion.

3.2 OBJECTIVES TO BE ACHIEVED THROUGH THE PAN-EUROPEAN STANDARD

The GSM standard - the standard for the Pan-European Digital Cellular System named after the GSM group which prepared it - ensures that the following objectives are achieved:

- Priority of the telephone service, for which the system has been optimized

- Roaming throughout Europe ("call pickup anywhere")

- Better transmission quality

- Utilization of the digital transmission channel for providing data services as well

- Service integration, i.e. access to various services from one mobile station using one call number

- Considerable improvement of security aspects such as the protection of the secrecy of telecommunications and the protection from misuse

- Favourable conditions for the supply of handheld equipment

- Initiation of an evolution going beyond the standardized services

- Definition of open, company-independent interfaces between the main components of the system, i.e. the mobile switching centres, the base transceiver stations and the mobile stations, in order to achieve intensive competition in the field of procurement.

3.3 SERVICES

The question as to the GSM standard's ISDN capability is asked very often. Both make service-integrating networks possible. However, after deduction of the transmission capacity for error correction, considerably less than 16 kbit/s is available in the GSM system as compared with 64 kbit/s in the ISDN.

GSM is optimized for the telephone service, while ISDN is designed to be a universal network. It goes without saying that for the telephone service a link between the GSM system and the ISDN has to be established. For the other telecommunication services, network and service interworking will be provided, if this makes sense from the user's point of view, is technically feasible and economically viable.

The implementation of transparent 64 kbit/s channels as an extension of transparent ISDN bearer services is not possible for reasons of frequency economy, costs and quality of service. But as soon as telecommunication services with flow control and error control procedures have been defined in the ISDN, the most important preconditions for a link to the GSM network will exist.

The following teleservices have been standardized:

- the telephone service (including emergency calling)
- 3 short message services
- 3 videotex access services
- the teletex service
- facsimile (group 3)

The following bearer services have been standardized:

- several data transmission services, circuit-switched, asynchronous, duplex to the tele-

phone network/ISDN, operating at 300 ... 2,400 bit/s
- several data transmission services, circuit-switched, synchronous, duplex to the telephone network, ISDN and circuit-switched data networks
- data transmission services with PAD access (Datex-P), circuit-switched, duplex, asynchronous, 300 ... 9,600 bit/s
- 3 data transmission services, access to packet-switched data networks, synchronous, duplex, 2,400, 4,800 and 9,600 bit/s.

Supplementary services like call diversion or closed user group supplement the above teleservices/bearer services.

3.4 MOBILE STATIONS

Of particular importance for the success of the service are the mobile stations. A wide range of mobile station types has been defined, from which manufacturers and users are able to select freely. A uniform European specification for the type approval of mobile stations is being developed. Once obtained, the results of the technical tests are to be recognized in all European countries without any additional tests.

In accordance with the basic ideas of the single European market, the free movement of mobile stations in Europe will be ensured, i.e. there will be no lengthy import and export procedures at the borders.

3.5 SUBSCRIBER RELATIONSHIP

It is only with one network operator that the user has to enter into a subscriber relationship. Such a relationship also covers the use of services in all other European GSM networks. The relevant questions concerning charges and international accounting have been solved in principle. It is important for instance that charges payable by a subscriber roaming abroad are debited to his account through the bill he receives from the network operator in his home country.

3.6 THE GSM SYSTEM

Figure 2 shows the system configuration. The most important technical data are summarized in figure 3. Consensus has been reached at European level on the twofold provision of 25 MHz in the 900 MHz band. A digital transmission technique will be used, and 22 kbit/s will be available on each traffic channel. Speech will be digitalized at 13 kbit/s. In addition, 9 kbit/s will be available for error-correcting information, in order to achieve an adequate service quality via the radio path. Data transmission can be effected at a data signalling rate of up to 9.6 kbit/s. The remaining kbit/s (up to the 22 kbit/s available) are intended for error correction, synchronization, etc.

Within the system user data channels operating at half the bit rate (half-rate channels) can also be provided. This allows duplication of the useful capacity as soon as speech coders are available for speech digitalization with about 6.5 kbit/s. For data transmission, however, these half-rate channels can be used immediately. 8 full-rate channels or 16 half-rate channels at a time are transmitted on a radio channel with a bandwidth of 200 kHz using time division multiplexing.

A distinction has to be made between radio and switching subsystems.

Radio functions are implemented in the base station system, which consists of the following components:

- o Base Transceiver Station (BTS) for the implementation of the radio interface to the mobile subscriber terminals and
- o Base Station Controller (BSC) for the implementation of radio control functions and for use as a concentrator.

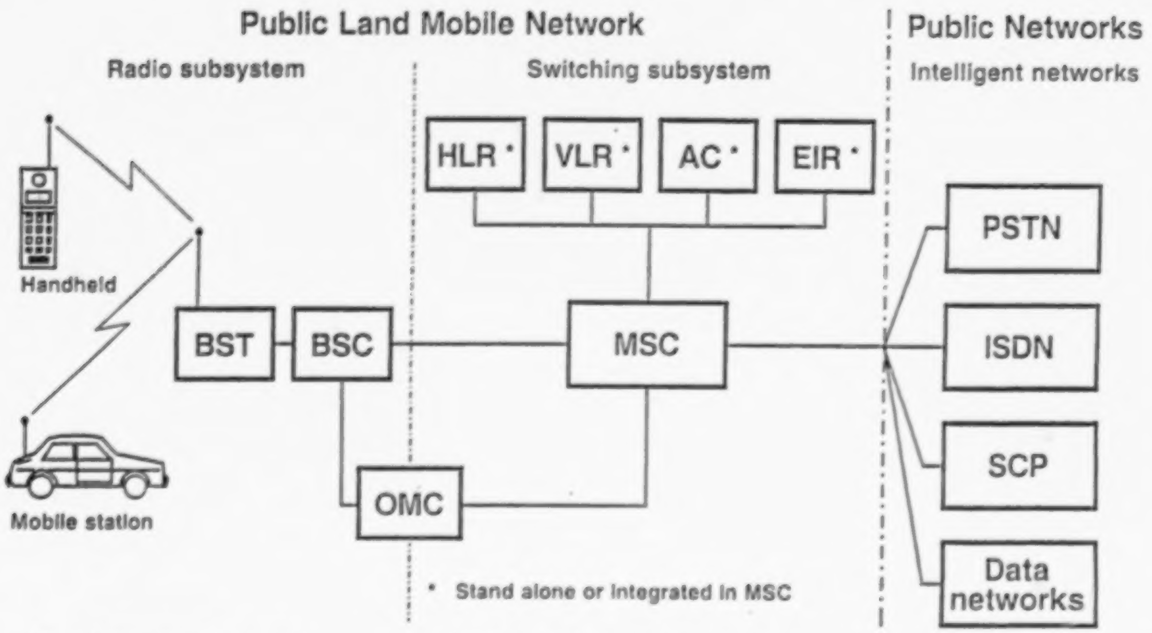
Switching or network-oriented functions are implemented in the switching subsystem including the following components:

- o Mobile Services Switching Centre (MSC)
- o Home Location Register (HLR)
- o Visitor Location Register (VLR)
- o Authentication Centre (AC)
- o Equipment Identification Register (EIR)

The main functions of the switching subsystem are channel administration, interworking with partner networks, call control and signalling as well as mobility management covering for example location registration and call handover. The division of functions and the interface structure follow the principles of the Intelligent Network.

3.7 DEMAND FORECASTS AND SCHEDULES

In all European countries there is a strong demand for mobile telephone services. In quite a number of countries this future demand cannot be met with today's systems. These systems are not compatible throughout Europe. Furthermore there is a demand for high-quality data and telematic services using transmission rates between 300 and 9,600 bit/s, and there is a demand for the supply of handheld mobile stations. This demand can be met through the GSM services.


Public Land Mobile Network
Public Networks
Radio subsystem
Switching subsystem
Intelligent networks
HLR *
VLR *
AC *
EIR *
Handheld
BST
BSC
MSC
PSTN
ISDN
SCP
Mobile station
OMC
Data networks
* Stand alone or integrated in MSC

AC	Authentication center	MSC	Mobile services switching center
BSC	Base station controller	OMC	Operation and maintenance center
BST	Base station transceiver	SCP	Service control point
EIR	Equipment identification register	VLR	Visitor location register
HLR	Home location register		

System architecture

Figure 2

Frequency band	900 MHz: 124 radio carriers in the CEPT paired band (890-915 MHz and 935-960 MHz. Spacing: 200 kHz
Transmitted rate	270.833 kbits/sec. A single bit has a duration of 3.7 micro-sec
TDMA frame	4.615 ms, 8/16 channels per carrier Each radio carrier is time division multiplexed and a basic frame consists of 8 time slots
Modulation	Gaussian Minimum Shift Keying (GMSK): modulation index of 0.30
Channel coding	Convolutional code
Speech coding	13 kbit/s regular-pulse excitation with long-term predictor (RPE/LTP)
Path equalisation	up to 16 micro-sec time dispersion

Figure 3 The most important technical data of the GSM system

The demand for GSM services in Europe is estimated to be 10 to 14 million mobile stations by the end of the next decade. Demand for more than 2 million of these will be accounted for by Germany. 10 per cent of the mobile stations are expected to be used for data and telematic services; 30 to 40 per cent will probably be handheld devices. The total market will have a volume of 15 to 20 billion US dollars, which will be equally divided between the infrastructure and the mobile stations.

The 20 signatories of the Memorandum of Understanding have committed themselves to starting GSM operations in their conurbations in 1991. In line with demand, nationwide coverage will be achieved within the shortest possible time: in Germany presumably within 3 years, in other countries this may take longer.

3.8 INTELLECTUAL PROPERTY RIGHTS

A new standard that would ensure a quasi-monopoly position for one or only a few patent holders as regards property rights was not acceptable to the European operating agencies that had acceded to the Memorandum of Understanding for the Introduction of the Pan-European System. The MOU goal to achieve a quick and unrestricted market penetration under the best possible commercial conditions would have become unattainable.

But also the manufacturing industry as a whole benefits if restrictions on property rights are removed:

- the sales market grows faster and develops dynamics of its own
- the position of manufacturers who offer systems based on a widely used standard is strengthened in global competition.

Of course, this may lead to inequities if the companies involved contribute patents to a varying degree. These imbalances can be levelled through fair and adequate licence fees. What is important is that use of the standard is not blocked through the refusal to grant patent licences. The MOU signatories have committed themselves to placing orders only with those suppliers who agree to have their patents passed on under appropriate conditions. If the passing on of patents were restricted to Europe only, this would clearly contradict the principle of free world trade.

3.9 THE ADVANTAGES OF THE GSM SYSTEM

The GSM system represents the first digital mobile radio standard worldwide. Validation programmes have proved that it works well. The standard was specified for a technology which was not yet available at the time when work on the preparation of specifications started. Today this courageous approach is rewarded by the fact that GSM uses the most advanced technology and will thus take a prominent place as far as price and quality are concerned.

The European mass market will result in low cost for the mobile stations and for the infrastructure. The philosophy of open, non-proprietory interfaces, independent of the manufacturers, allows for configurations comprising components from various manufacturers. Intensive competition is already noticeable. So is the cost-reducing effect of the TDMA technique which provides for the transmission of 8 or 16 voice channels via a radio carrier. The cost of using leased circuits between the two kinds of base stations and between the base stations and the mobile switching centre can be clearly reduced by channel splitting (i.e. four 16 kbit/s voice channels via a 64 kbit/s circuit).

The GSM standard is one of the first examples of an intelligent network and thus leaves ample scope for the introduction of new services and facilities.

4. OTHER DIGITAL MOBILE STANDARDS

The USA and Japan in particular have been studying for some time the methods used in the preparation of standards for digital mobile radio.

In January 1989 the American CTIA (Cellular Telecommunications Industry Assocation) decided in favour of a TDMA technique. Standardization work was to be completed by the end of 1989. (Since this paper had to be written as early as November 1989, comments on the result of CTIA's efforts cannot be made as yet.)

In April 1989 a group of experts set up by Japan's Ministry of Posts and Telecommunications also recommended the early introduction of a digital mobile radio system. It is not yet clear whether they will decide in favour of FDMA or TDMA.

In the USA one important criterion for this decision was the strategy to be applied in the transition from the available analogue standard to the digital standard, as the new system is to be accommodated in the same frequency band. They will therefore choose a technique which allows the implementation of 3 or 6 TDMA channels in an existing analogue channel with a bandwidth of 30 kHz. This standard thus serves primarily to increase the capacity within the existing mobile radio environment. It therefore cannot benefit from the advantages offered by a newly designed digital system: improvement of the service quality, introduction of non-voice services, encryption, authentication or 8/16 channels per radio carrier.

The GSM system is the ideal solution for all those countries where there is no constraint to fit the new digital system into the existing channel arrangements for analogue systems. The GSM system is ready for introduction, there is a multitude of manufacturers and soon enough there will be a large market for the most different types of terminal equipment.

5. TRENDS FOR FUTURE DIGITAL MOBILE STANDARDS

5.1 RACE PROJECT ON PERSONAL COMMUNICATIONS

The European Community promotes a project named "RACE" (Research into Advanced Communications in Europe). This project is aimed at the development of an Integrated Broadband Communication Network. One part of it concerning "Mobility" deals with mobile radio and in addition with the application of "Mobility Management" in both the mobile radio networks and fixed networks.

The programme on mobility concerns the development of the Universal Mobile Telecommunication System (UMTS). It includes 4 main targets:

- Definition of functions for the fixed network in order to support the connection of high-capacity mobile radio networks;

- Definition of a radio interface for use in private households, at the office and for outdoor operations, in large-cell as well as small-cell structures;

- Support in the allocation or opening up of new frequency bands;

- Preparation of specifications that can be changed into standards by CCIR or ETSI.

A number of results have already been achieved:

- An experimental programme for the transmission of 1 Mbit/s at 1.7 GHz comprising 36 micro cells; this programme also investigates the possibility of dynamic channel assignment;

- A simulation model for the comparison of different radio subsystems;

- Comparison of three techniques to adjust transmission bit rates for use in indoor or free-space propagation.

Some participants in the programme prefer GSM or DECT (Digital European Cordless Telephone) as the basis for UMTS. The great advantage of GSM would be that no new architecture for the switching and service functions would have to be developed.

5.2 CCIR WORKS ON FUTURE LAND MOBILE TELECOMMUNICATIONS SYSTEMS (FPLMTS)

CCIR/IWP 8/13 sees, from a user perspective, that differences between the services provided by the fixed and mobile networks respectively will lessen in the future. The terms "continuous" and "discrete" mobility were defined to differentiate between what can be achieved by wireless and wireline networks.

A lightweight personal pocket radio would be a dominant feature of FPLMTS which should be usable anywhere worldwide with the inherent implication of a requirement for a single radio interface standard. It seems to be a combination of the existing cordless and cellular handportable units and is called a Personal Station (PS). Using a PS as a cordless telephone in conjunction with a mobile station, one could extend a mobile link by a tandem personal link, for instance in train, buses, aircraft, leading to a mobile telepoint concept.

It may be possible to provide services up to the primary ISDN rate of 1,356 kbit/s (North America) or 1,920 kbit/s (Europe) when the mobile station is stationary, or moving slowly close to a base station which is not heavily loaded.

The total bandwidth required for voice and non-voice services ranges from approximately 230 MHz (conservative projection for future technology) down to approximately 180 MHz (optimistic projection for future technology). The use of a band between 1 and 3 GHz would be suitable.

5.3 PERSONAL COMMUNICATIONS NETWORK (PCN)

In the first half of 1989 the British Department of Trade and Industry (DTI) invited applications for PCN licences. They deliberately did not prescribe a specific concept for PCN; the only requirement they made was that the standard should be based on GSM or DECT or on a combination of both. A frequency band of 200 MHz between 1.7 and 2.3 GHz is planned to be used.

A great deal of commonality between PCN and GSM is highly desirable. One important factor to take into account is that GSM is now fully defined on most significant points, while DECT is not yet defined to the same degree. PCN could be developed directly in line with GSM, while the difference - in particular on the network side - appears to be greater between what DECT is intended to be and what is desired in the PCN.

Based on GSM, there are two approaches, i.e.

- a direct expansion of GSM, using extension bands. The result would be an updated GSM, and this would probably fit in with the expected development of GSM, since a "second generation GSM" will certainly be needed before 1995 anyway.

- a completely separate system, using frequencies in the range 1.7 - 1.9 GHz. Such a system would also have a great deal of commonality with GSM, except for the radio subsystem, which would be rather different.

In both cases, the network subsystem of GSM would be very well suited, since most - if not all - of the functions required for the PCN network subsystem are already there.

Thus the question to be answered is not only whether the GSM standard is suitable for use outside Europe, but also whether it can provide a reasonable basis for new mobile radio services. From my own point of view I can confirm this.

6. THE ADVANTAGES OF WORLDWIDE COOPERATION IN THE DEVELOPMENT OF A FUTURE UNIVERSAL MOBILE RADIO STANDARD

In the eighties the discontent of the European mobile radio users with the large variety of incompatible mobile radio systems is restricted to Europe. In the coming decade, however, our customers will ask why they cannot use their handheld equipment outside Europe as well. Why shouldn't it be possible for them to take their handheld telephones on journeys abroad, just as they do with laptop PCs.

Starting with the 3rd mobile radio generation, which is being considered already in the CCIR and research programmes, the differences between fixed and mobile radio networks will become fluid. The keywords used here are: telepoint, radio PABXs, replacement of expensive local lines by mobile radio, coverage of remote areas by radio, public aeronautical radio, etc.

A vast number of different standards require expensive adaptation solutions which burden the national economy. For it is this large variety which prevents synergetic advantages like large markets that reduce the cost per customer. As a result, the mobile radio market will be opened at reduced speed.

A possible transitory solution would be the introduction of a "Subscriber Identity Module" that can be used worldwide, a smart card with a processor chip which would allow customer friendly use and billing even in countries with different mobile radio standards.

The excellent results achieved in Europe with the impressive standardization work on GSM should not be confined to Europe. The standardization institutes around the world must join forces and adopt a common approach on the basis of cooperation agreements. Only in this way will it be possible to realize the dream of a Universal Mobile Telephone System.

(1) CEPT = Conférence Européenne des Administrations des Postes et des Télécommunications, European Conference of Postal and Telecommunications Administrations
ETSI = European Telecommunications Standards Institute
GSM = Groupe Spécial Mobile, Working Group of CEPT for the Development of the Pan-European Digital Cellular System

Emerging Mobile Data Communications

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1. ABSTRACT

Public mobile data communications networks are under construction or already online in many nations of the Western World. These packet-switched radio-frequency systems are characterized their ability to perform two-way interactive bursty communication. These new networks will not compete with existing communications networks, but instead will complement and enhance them. This paper will discuss applications uniquely suited to this type of mobile data communications.

2. INTRODUCTION

In the ongoing transformation of communications systems, one of the next steps is the emergence of a public mobile data communication network. Similar in some ways to existing mobile networks, this next generation network goes one step further, it is for data exclusively.

Anyone claiming that mobile data communications networks will compete with existing networks such as land-based packet-switched, cellular, or private mobile radio systems is wrong. Instead, mobile data communications will carve out a new niche in the communications environment and will be best put to use where it will enhance and complement existing networks.

Existing voice dispatch mobile radio systems are not an option for most users because they have limited capacity and tend to be private proprietary systems. Even if frequency can be obtained, entry costs are prohibitive because large capital investment is needed along with the ability to set-up an in-house telecommunications company.

Unlike private mobile radio systems, Cellular is available on a widespread basis, but it too has limitations for mobile data communication users. Similar to many voice networks, cellular is circuit switched. Call set-up times of five seconds, while acceptable for voice, is cumbersome for the data user. Additionally the cellular data user has to cope with the handoff problem which can drop significant amounts of data during the switch of base stations. Though it can handle large amounts of data or batch processing, it is not suited for short, frequent, two-way data traffic.

One mobile data communications system known as Mobitex, has recently met with U.S. approval and been given licenses to operate in 50 cities. Network construction and operation by RAM Mobile Data is underway and service is expected to be available in some cities in the 4Q 1990 with the remaining completed by early 1992.

Mobitex is a packet-switched radio-frequency technology which was jointly developed by the Swedish PTT and Ericsson. This type of mobile data network is already operational in Canada, Finland, Norway and Sweden and soon to be built in the UK.

3. APPLICATIONS

Below are examples of where mobile data communications will enhance and complement existing applications and networks.

3.1 FIELD SERVICE

Whether it is for delivery, maintenance and repair of industrial equipment, foodstuffs, copiers or for a computer systems engineering concern, mobile data communications can improve productivity of the field service personnel(FSP). It is no longer necessary for the FSP to physically pick-up work orders at the main plant or head office at the start of each day. Work orders are dispatched regardless of where each vehicle in the fleet is. A routine service call schedule can be amended instantly on an as needed basis to accommodate emergency or high priority calls as they occur during the day. FSP personnel can tap into the customer's data base from a remote location to check on work repair history or the availability of parts.

Invoices can be generated instantly, onsite, agreed to and signed by both parties at the time each job is completed. Avoided is the average four day time lag between service completion and invoice generation. Since the person that does the job also generates the invoice, the number of mistakes tends to be reduced. It is estimated that each mistake avoided in the billing cycle saves the field service company an average of $70.00. Labor costs are decreased because a company can cut back on the number of accounts receivable personnel and eliminate paperwork at the same time.

3.2 "JUST IN TIME" INVENTORY DELIVERY SYSTEMS

Many large manufacturers, most notably automobile plants, have adapted "Just in Time" inventory delivery systems to cut costs and improve plant efficiency by drastically cutting the amount of inventory on hand. This method of inventory management tightly paces deliveries according to the production schedule. In order for this system to work both the supplier and the plant have invested significant capital in information systems.

Although the supplier and the plant are linked electronically, there is however, a missing link. Once the supplier has filled the order and the truck leaves the supplier's yard, there isn't anyway of tracking the truck on the way to the plant. With the clock ticking, the plant has no way of knowing if the truck is around the corner, or has a flat tire. With a mobile data communications solution an inexpensive automatic vehicle locator(AVL) device is attached to each truck and both the supplier and the plant know exactly where the delivery is at any point along the delivery route. If there is a problem the supplier is immediately aware and can dispatch a another truck "just in time" which prevents costly plant downtime.

3.3 PUBLIC SAFETY

City, County and State Police, Fire departments each have had their own separate and proprietary radio-based mobile voice communications systems since the late 1940's. In addition private ambulance companies work off yet another network. While this has improved the efficiency of public safety immeasurably and saved countless lives as well, coordination among the agencies has not always been smooth.
A central voice-based dispatch coordinates activities among these different agencies. For example, the Fire department(FD) gets a four engine call and needs the police to divert traffic away from two streets. The Captain calls dispatch and is patched into the Police net where the request is made to a peer. The Police Captain radios the appropriate PD unit(s) to the scene. This hierarchal method works in most situations, but there is always a danger of bottleneck at the dispatch point. Multiple the emergency by a factor of 10 or a 100 in an natural disaster situation i.e., earthquake, hurricane, blizzard etc., and the hierarchal dispatch method quickly degenerates into an unworkable situation. Not surprisingly it is in times of multiple emergency, when quick communication and coordination among the various agencies is most important, that these networks will be most inefficient.

A separate mobile data communications network can be on call for emergency situations like this. Technically speaking it is a neutral overlay network or bridge that can be dynamically allocated on demand. It complements and works with existing Public Safety networks. No one agency controls the network or its frequency, but all have equal access to it on a non-hierarchal basis. Resources are not allocated by who can get through to dispatch first, but can be deployed in a quick and efficient manner according to the priority assigned by each agency. For example, the police captain can receive multiple requests for service and deploy the necessary resources simultaneously with a mobile data network, something that is impossible to do with a voice-based network.

3.31 LAW ENFORCEMENT DATA BASE ACCESS

Many states already have the ability for mobile police units to match state and federal law enforcement data bases with the vehicle in question. This capability has generally become available in the last decade. Timely information on the status of a vehicle that has just being pulled over can literally be critical to the safety of the officer.

For example, what may appear on the surface to be just another law abiding citizen driving a vehicle with a headlight out, could in fact be a stolen vehicle driven by a wanted criminal. The old adage, "knowledge is power" could be reworded in this situation to "knowledge is the life and safety of a police officer". It is essential that the officer knows the status of the vehicle in question as soon as possible, preferably before it is approached. Unfortunately in many situations, there is often a time lag between sending and receiving this information--a time lag that could be fatal to the officer approaching the vehicle in question.

Typically this is how a search is done today. A car is pulled over for a vehicle or traffic violation. The officer radios in the license number to the local headquarters where someone manually keys in the number and the search begins. Once the computer replies then the person radios this information back to the officer. Bottlenecks can and do happen. Since each police department has a limited number of voice channels, they are often blocked by others making similar requests. If an officer does get an open channel the next bottleneck can occur at headquarters. There maybe more requests for searches at any given moment than there are personnel to handle them. In these situations the officer may elect to approach the vehicle first--gambling that the occupant is not a threat--and call in the license number later.

Replace this system with a mobile data solution and the send/receive turnaround time is cut substantially. The officer keys in the license number from the law enforcement vehicle and the search begins. Voice channel availability is no longer an issue and these channels are freed up for other uses more suited to voice. In addition, the officer is no longer dependent on someone being available to key in this information. When the search is completed, the information goes directly back to the officer's LCD readout, avoiding the middleman both coming and going.

By removing the need for the middleman, fewer people are needed at headquarters performing the search functions. This is a cost savings that directly affects the bottom line allowing police departments to reallocate budget resources. More importantly, the quicker turnaround time (computers are much faster than the fastest keypunch operator) greatly improves the safety of the officer doing the search and decreases the amount of time it takes to process each vehicle.

It is important to note that some jurisdictions already have the data capabilities mentioned above. The drawback for these systems is the sacrifice of scarce frequency that could otherwise be used for voice purposes. At least one dedicated voice channel is necessary which is an inefficient and wasteful way to send data. Mobitex, because it uses its own frequency, does not use existing and invaluable public safety frequency to work. And although it is a public network, personalized and customer controlled security and encryption features are inherent aspects of the technology.

Current implementation of data network features is expensive because Public Safety agencies have historically been dependent on one supplier for equipment. Because the Mobitex network is based on an open architecture with published specifications, there will be a number of manufacturers of terminal equipment competing with product offerings to make these capabilities possible. There will also be opportunities for software developers to develop application software. Competition tends to drive the price down while improving quality and features offered.

4. CONCLUSION

These are some examples of the way mobile data communications can improve grade of service and productivity of companies and organizations by enhancing and complementing existing communications options that are technically available.

UNIFYING THE CELLULAR STANDARDS

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The busy world of today requires people's availability and accessibility at all times. With the advent of mobile communications,this has now become increasingly possible. Mobile telephone have an increasing impact on both personal and business communications. But the different system standards currently in use vary greatly, making the choice of system no easy task.

Modern mobile telephone systems are said to be cellular. The word "cell" refers to the shape of the coverage area of the radio base stations. Contrary to the older generation mobile telephone systems, cellular networks show the important property of being able to provide continuous calls even if the subscriber moves from one cell to another.

The radio frequency band-width used for mobile telephone systems is divided into channels, each capable of carrying one call. Consequently, the basic measure of the system capacity is the number of radio channels available.

In order for a subscriber to be able to make a call, he must be within a cell and there must be a free radio channel. Using the channel, the call is connected to the mobile telephone, to a fixed local telephone or to the international network.

Four widespread system standards

The first cellular mobile telephone system standard in the market was NMT-450, a system specified by the Nordic telecommunications authorities (NMT standing for Nordic Mobile Telephone system), and put into use in 1981 in Denmark, Finland, Norway and Sweden. NMT-450 operates in the 450MHz frequency band and, due to its low channel capacity and good radio coverage, is most suitable fo use in areas with fairly low traffic density. Currently, there are over 600 000 NMT-450 users in the world.

In 1983, the AMPS (American Advanced Mobile Phone System) was introduced in the United States. Contrary to NMT-450, which was designed to provide nationwide coverage, AMPS was the first city-oriented system. Its capacity is almost four-fold as compared to NMT-450, but, on the other hand, it operates in the 800 MHz frequency band, having physically inferior radio wave propagation characteristics. This implies that the maximum cell sizes in AMPS are smaller than in NMT-450 and that, consequently, building a nationwide AMPS network is more expensive that building an NMT-450 one. Today the number of AMPS users is, due to the huge market in the USA, over 2 million.

Based on experiences with AMPS in the USA, its European counterpart TACS (Total-Access Communication System) was introduced in 1985 in the UK. TACS has 50% more capacity than AMPS and operates in the 900 MHz frequency band, further decreasing the maximum cell size. Nonetheless, TACS was meant to provide nationwide coverage in the UK. The two competing British TACS operators have developed their networks to provide wide coverage, but to achieve this they have each had to invest nearly 400 million USD in their networks, in the four years since the service started. The current number of TACS users is about 500 000.

The most modern of today's standards is NMT-900, developed by the Nordic telecommunications authorities. NMT-900 went into full operation in 1987 in the Scandinavian countries. Like TACS, NMT-900 is operating in the 900MHz frequency band, and was first introduced in the bigger Scandinavian cities where NMT-450 showed capacity problems. In Denmark, NMT-900 currently provides nationwide service, whereas in larger, less densely populated countries like Sweden and Finland it is still city-oriented. After two years of operation, the number of NMT-900 users already exceeds 150 000.

Keys to system success

Measured in terms of mobile telephone penetration, i.e. the number of mobile telephones per 1000 inhabitants, NMT systems are by far the most successful ones. In Scandinavia alone, the NMT systems have reached a joint penetration of over 26 while, e.g., the British TACS networks and the American AMPS show a penetration of less than 9.

The keys to success are, in fact, simple. The mobile telephone network has to provide enough disturbance-free capacity and a full coverage of the intended operational area. This means that a subscriber should always, also during the peak traffic hours, be able to make and receive calls within the area where the mobile telephone network is expected to operate.

It is safe to say that every operator setting up a mobile telephone network with enough coverage, adequate capacity and an interference-free cell

configuration, will be successful in a market where sufficient potential demand exists. It is also evidenced in many markets that the mobile telephone prices are set by the market forces alone and are, consequently, not system standard-dependent.

Technical comparison - user's point of view

Capacity

The capacity of the different systems varies greatly. AMPS occupies a bandwidth of 20 MHz divided into 666 channels, each 30 kHz in width. TACS provides up to 1000 25-kHz channels over a bandwidth of 25 MHz. NMT-900 has the largest capacity with its 1999 channels, each 25 kHz in width. NMT-900 channels are interleaved, or overlaid, so that total bandwidth is the same as in TACS, i.e. 25 MHz. In the UK, where the TACS networks have suffered from congestion problems, the so-called extended TACS, or ETACS, has been introduced. Lately, the same system has also been introduced in Malaysia. It offers an additional 240 channels but occupies, consequently, another 6 MHz of bandwidth.

The differences in capacities are obvious to the telephone user, for whom the lack of channel capacity shows as an inability to make or receive calls or as an abrupt cut-off of a call on moving from one cell to another.

Handportables

When AMPS and TACS systems were designed, the fast market penetration of small handportable telephones was unforeseen. Consequently, although AMPS and TACS both allow handportables, they include no special features supporting their use. On the other hand, the NMT-900 network was designed taking handportables into account in many ways.

The main problems with the handportables are their low radio transmitter power and the difficulty in predicting where the telephone moves (or, more precisely, where its carrier moves). The low power causes problems with cell coverage, as the users of handportables may not be able to make or receive calls on the edges of the cells where the radio signal is weaker.

When handportables are carried on the upper floors of tall buildings their effective antenna height is increased, and their weak radio transmitter turns into a powerful radio capable of disturbing other telephones and even radio base stations within the vicinity. The other problem related to portability is the difficulty in planning the cells in a way which secures an adequate coverage. With the increasing popularity of handportables, it no longer suffices to provide coverage along the roads and other traffic lanes, but the coverage must also extend to individual buildings and business complexes.

NMT-900 is the sole system where handportable users are identified at the mobile exchange. This implies that the system is able to monitor the movements of a handportable user and control the transmitter power level of the telephone. If unusually high transmitter power is sensed, say, due to an increase in the effective antenna height, the exchange automatically commands the telephone to lower the power. When the telephone is brought back to normal operating conditions the original power is restored.

Another concrete benefit for handportable users in the NMT-900 network is the system's battery-saving feature. Typically, the battery of a handheld telephone would last from 8 to 18 hours if the telephone is on standby, i.e. waiting for calls. With the battery-saving function in NMT-900, where the exchange controls the telephone by switching them off and on from time to time and queuing the incoming calls if necessary, the battery life time can be increased to at least 30 hours. The TACS system, in fact, also has a battery-saving feature but is based on a voice-activated transmitter which saves batteries only during calls. Furthermore, in noisy environments, such as in the street, the gain may be nullified if the transmitter is on all the time.

Roaming

The NMT systems are the only systems in use with a good reference of international roaming. Roaming is the ability of a subscriber to use his mobile telephone in other countries using the same standard. For instance, it is possible to use the same telephone in the four Scandinavian countries and Switzerland.

In the AMPS and TACS networks, inter-operator roaming is impossible unless several subscribers numbers and, hence, several subscription and monthly fees are assigned to a single telephone. This is due to the fact that the so-called control channel frequencies used for carrying various system-controlling signals are fixed within an AMPS or TACS network and preprogrammed in the mobile telephone, and that the AMPS and TACS telephones are not able to identify the operator.

System profitability - operator's point of view

Building and Expansion Costs

To the operator, the building and expansion costs of the networks are the major differences between the system standards. Although many manufacturers can provide telephones to an AMPS or TACS network, AMPS and TACS themselves are proprietary to their builders. Therefore, an AMPS or TACS operator is bound to one single system supplier throughout the life of the network.

On the other hand, NMT-450 and NMT-900 are systems with open speicifications. This implies that many system manufacturers provide compatible components to NMT networks. As an example, there are up to eight manufacturers of NMT-900 base stations, each able to supply their products to any NMT-900 network. Such wide competition has imposed a sharply declining price trend for the NMT-900 system components, not experienced with the proprietary AMPS and TACS systems.

Capacity

In city-oriented networks, the differences in capacity between the system standards can be directly translated into differences in operating profits. Due to its lower capacity, an AMPS network pushed to its edge accepts a lower number of subscribers than a TACS network, let alone an NMT-900 network.

In addition, should changes in the traffic distribution occur, a high-capacity network is easier to replan and reorganize than a low-capacity one. This obviously results in improved total economy.

Call Charges and Prices of Mobile Telephones

The call charges as well as other subscriber fees have to be set in the right manner. If they are too high, the subscribers are not encouraged to employ their mobile telephones and the operator's revenues will decrease; if too low, the number of mobile telephone users may increase too rapidly and cause congestion of the network. In other words, the operator must be able to determine the price sensitiveness of the subscribers and find a price level which optimizes both the revenues and the rate of network usuage. As a rule of thumb, call charges at least double to the ones applied in the fixed telephone network are employed.

The prices of mobile telephone sets have sometimes been said to have a considerable influence on the success of the network. However, the different markets in the world do not justifiy this belief. Basically, i.e. production-wise, the prices of telephones for AMPS, TACS and NMT-900 are the same. In the USA and the UK, the competing AMPS and TACS operators, respectively, subsidize the telephone prices by paying one-off and annual bonuses per subscriber to the retailers of the telephones. Consequently, the US and UK telephone prices have been artificially low for some time. Still, the NMT-900 networks in Scandinavia and Switzerland have grown faster.

Future

All of the present mobile telephone systems are analog, which implies that the information (speech or data) is transmitted as a frequency-modulated analog signal over the radio path. The next generation of mobile telephone systems will be digital, i.e. all information will be carried as bits, encoded in the transmitting end and decoded in the receiving end.

The first digital system has been defined by GSM (Groupe Special Mobile) set up by CEPT (Conference Europeenne des Postes et Telecommunications) already in 1982. GSM has managed to combine all the European resources to work towards a common goal: a pan-European digital mobile telephone system. The results of this effort will be taken into use in the forefront countries, like the UK, France, Germany and Scandinavia, by 1991. Eventually, GSM will provide uniform European-wide service covering over 20 countries.

GSM will also offer a large variety of new services, including ISDN (Integrated Services Digital Network) compatibility. The most modern knowledge from the areas of mobile communications, ISDN and information processing is being assembled to meet the needs of the new networks. One of the major powers in the GSM market is ECR 900, the consortium between Nokia, Aclatel and AEG, which already has been awarded contracts to build GSM test systems in France, Germany and Holland.

As independent market study organizations predict GSM to be in wide operation in Europe by 1992-93, it is likely to ploriferate to other parts of the world by the mid-1990's. It is, however, important to note that many present analog systems will continue to grow at least until the end of the century, and that new analog systems will be set up before the digital ones make their breakthrough. As an example, in France, Nokia has just completed a large NMT network. Other new analog systems will be built in countries like Algeria, Austria, Pakistan, the Philippines, Greece, Indonesia, Malaysia, Thailand, and Spain. These networks are expected to be operational for at least twenty years after their introduction.

Future of mobile communications; continuous rapid growth, challenges on all fronts

Single standard - market liberalization

GSM will bring about a radical change from a multistandard, fragmented market into a single standard market characterized by large volumes. Jointly specified, open interfaces can be claimed to be the single most important attribute of the GSM system.

The provision of open interfaces results in the Pan-European roaming facility and natural incentive for the industry to enhance its competitiveness. Hence it will have a strong catalyzing impact on the telecommunications industry. It opens the market for multivendor and multisourcing environment. Network operators will be no longer dependent on a single system supplier with proprietary interface specification. This will lead to faster introduction of new product generations and lower prices for equipment.

This development has already been experienced in

Nordic countries where openly specified NMT systems have been in use since early 1980's. While networks have grown with the rate of 45% in the recent years, the prices per channel have continued their decreasing trend.

Because of roaming facility between the countries and openness of the standard specification it is justified to call the Nordic NMT network 'pre-GSM'. Thanks to these qualities the Nordic cellular networks as already mentioned, now have highest penetration figures in the whole world.

During the launch of the GSM networks, the market is clearly a system market. Later, when the standard has been stabilized, the network operators are expected to procure the different system elements from several suppliers.

The new technology, and the large volume market, is an attractive opportunity for not only existing cellular equipment suppliers but for the new entrants as well. The new entrants come from both traditional telecom industry and other companies seeking their fortune in this business of high growth potential. Due to heavy R&D expenditures and keen competition, a major 'hiccup' in the structure of the mobile communications industry is therefore to be expected. Competitiveness will be measured in terms of ability to deliver the equipment within the tight schedules and flexibility to support operator in the network planning and construction by providing operator specific services and additional features.

From the industry point of view the introduction of digital cellular will take us from infancy to the early teens. Through the beginning of the 1990's most of the growth in mobile usage will still come from business and other professional users. With the advent of personal communications, the market will become consumer oriented and the industry will begin to reach adulthood.

Personal communications

Capacity of the system is the main concern for every operator. Shortage of frequencies combined with fast growing demand for mobile communication services have speeded up innovation and enhancements in both cordless telephony and cellular technology.

There are two main reasons why digital systems can offer more capacity. The first factor is efficient coding of speech. Only essential characteristics of the voice will be carried over the radio path. Original speech will be reconstructed in the receiving end. We do not expect that speech coding technology has reach its limits yet. The GSM recommendations have already made provisions for a codec with half the bitrate compared to the current one.

The second source for more capacity is the capability to protect the signal against corruption in the radio path. Efficient interleaving and channel coding schemes allow more co-channel interference and other degradation than analogue systems. Therefore the re-use distance may be shorter and re-use clusters have fewer frequency sets.

The capacity of mobile networks will be stretched to their extremes in large cities. Service users want to have light telephones which are easy to carry and use. Personal communications networks will be the next technological step to this end. Work has already begun with the development of the so called Telepoint networks and the standardization work on the Digital European Cordless Telephone (DECT). Plans are also underway to combine the concepts of digital cellular and digital cordless telephony into one advanced digital personal communications network. This system aims at alleviating the capacity problems foreseen in the GSM networks around the mid-90's, particularly in urban areas. The proposed frequency band for this service is 1.7 - 2.3 GHz and it is planned as an interim solution which will pave the way towards an integrated broadhand communications network, to be introduced in the late 90's.

The UK Department of Trade and Industry, on whose initiative discussion on personal communication networks was started, has wisely bound the PCN to an existing European standard, i.e. either GSM or DECT. The major difference between cellular and cordless based systems lies in predicting the customer location. In the DECT standard, the subscriber's location must be known to direct the incoming calls. In a GSM based system, the user can be anywhere and both receive and make calls

Development of European digital cellular network requires heavy investments from all parties involved. Hence it is important to take full advantage of those efforts. Commitments to GSM is necessary from the viewpoint of keeping European standardization work focussed and securing compatibility of the new mobile services in different countries.

There will be a need for multilayer cellular network. In addition to a 'basic' GSM cellular network, covering each country, there will be a network of microcells in large cities with a high density of population.

With some enhancements to the specification, GSM has a lot of potential as a solution for small cell city services, too. Although GSM was not designed solely and specifically for such environments, the standard provides sufficient support for light weight handhelds. Also, because the GSM standard is quite complete it provides a solid basis for further derivations of enhanced services, and increased capacity at new frequency bands without endangering compatibility of systems on European scale.

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Further in future, today known as RACE-mobile, the integrated broadband communications network will result in a personal communicator, based on a single air interface specification, that will provide all types of mobile services. Such services will include cellular, cordless telephony, wireless PABX, paging and private mobile radio. The intention is that all these systems will be fully interworking, and to the user they will appear as one comprehensive totally intergrated network. This Universal Mobile Telecommunications Service (UMTS) will operate in the frequency range between 1 and 3 GHz.

A multitude of choices

In the future there will be a multitude of products and services provided by several parallel existing networks. Analog, digital personal communications, private mobile and trunked radio networks will coexist well beyond the year 2000. The formula for success for both service operators and equipment suppliers will be the level of their understanding of the real needs of different user groups, and their ability to segment the market accordingly.

It has been estimated that, by the next decade 80% of all new subscription phone lines will be wireless. Around the year 2000, mobile telephony might well have reached over 30 percent of the adult population. Then the mobile personal communications tool will be just as common as the ordinary telephone is today. That is when we can start talking about an industry that has reached adulthood.

In order to make it that far, a supplier will need experience combined with an open, innovative and unprejudiced mind. And that is exactly the Nokia style.

Session 3.6

Special Japan Update

NOTES

Pacific Rim Challenges for Telephone Expansion

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ABSTRICT

How to increase the telephone is the most urgent issue in South East Pacific Rim Countires. NTT International Corporation points out basic problems to be overcome from their experiences in these countries' consultancy. Resources of both funds and human being, outside plant facilities and the ways for temporary installation of telephones are the items this paper mentioned of.

Look at the South East Pacific Rim countries - especially its big cities like Jakarta, Bangkok, Manila, etc. There are many sky-scrapers, and most of them are owned by banks, hotels and airlines. In the fancy hotels, there are broadcasts of NFL football games by satellite communications. Roads are filled with cars, and many of them are equipped with mobile telephones.

We, NTT International Corporation, provide consultancy services for these countries on how to efficiently develop their telecommunication facilities, as well as integration of computer systems. NTTI, as a non-manufacturing company, has much experience for the effective and relatively quick development of telecom facilities and provision of such systems, in providing long-term planning, and project management including design of facilities, specifying the products for procurement, and supervision of implementation and training.

Now, I would like to review our four years' experience in telecom facility expansion in these countries. The data indicates recent telephone penetration of the major cities of the area. These countries and cities are rapidly expanding their facilities. Japan also had similar experiences, starting with about 1.5 million telephones after 1945 increasing to 50 million telephones at present. Comparison of the cases of Japan and the South East Pacific Rim countries reveals many differences:

(1) Japan had the capability to produce the machines and equipment, including switches and transmission equipment, by herself. However, although the South East Pacific Rim countries are now trying to produce the machines and equipment for themselves, they have not effectively succeeded so far.

(2) In Japan 20 years ago, NTT was a public corporation and could draft its budget for itself. However, these countries absolutely require foreign currency at this moment so they can purchase the necessary machines and equipment, but their governments do not allocate resources to telecommunications - such resources are allocated for the construction of power plants, roads, ports and etc.

(3) Looking at relative size, Japan is a smaller country, so it is much easier to control or supervise telephone expansion.

(4) When telecommunication expansion started in Japan, computers were just beginning to be introduced, so "telecommunications" basically meant telephones. But today, these countries have introduced computers and the needs of such computer systems are, in some cases, much stronger than that of telephones. As you can easily imagine, sky-scrapers in these countries are already utilizing such computers. So, telecom authorities are requested to provide not only telephone services, but also high-quality networks for computer communications. Further, digitalization is another urgent topic to be solved.

When it comes to money for expansion, huge amounts are needed for initial investment. Especially when one considers that digging roads for cable installation, the present situation in South East Asian cities are much worse than that of Tokyo 15-20 years ago. To summarize, the problems for South East Pacific Rim countries are:

(1) How to obtain financial resources, including foreign resources, for expansion.

(2) How to quickly develop OSP (Outside Plant).

(3) How to manage the needs of computers in harmony with telecommunication facility expansion.

(4) How to maintain good human resources for telecom management, and how to train these persons for the age of digitalization.

Talking about finance or money, although these governments may understand that telephone businesses are quite profitable, they do not understand that intensive initial investment is required. As I pointed out before, these governments do not always understand that telephone authorities depend largely upon foreign currency to purchase key telecom products.

NTTI has experience with the subscribers' bond system in Japan, which is now being seriously studied in several countries. In korea and Taiwan, similar systems are being introduced.

Recently, the so-called "BOT" (Build, Operate, Transfer) or shared profit system is often mentioned, but has not yet actually produced good results. "OSP" (Outside Plant), which is my specialty, is the most difficult problem to solve, and is also a common problem for many developing countries in the Pacific Rim.

OSP engineering is really low technology in a certain sense, but without OSP no telephone or computer communication network with function. Especially thinking of civil engineering - let's say digging the road, which is quite difficult in big cities without creating traffic confusion - OSP engineering is the real key for telephone development. We also realize that there are few executives who understand the importance of OSP, and who come from OSP backgrounds. Not only the telephone sector, but also power, gas and water authorities must be well coordinated with the road management authority in order to dig and effectively use roads.

One day, I talked with the Governor of a big city, saying that we now have to dig the roads and we would like to ask the Governor's permission. His answer was, "Why don't you use my relative's construction company?" This response was very distant from the crucial coordination among telecom, water, gas, power, etc. which is required. I felt sad.

At this moment, NTT, with the cooperation of NEC, OKI and FUJITSU can offer the small-size radio subscriber system to protect sky-scraper's communications. This system was developed by NTT, in cooperation with manufacturers, after our experience a few years ago with a big fire at a cable vault just in front of a central office in Tokyo. We asked telecom authorities to use it temporarily for the cities where installation of underground cables is difficult due to heavy car traffic. The experiment will be carried out in some big cities in a few months.

Talking about OSP, plant records are also another problem, since it takes to design facilities without plant records. Usually, PR are very poor, and used as such only when the facilities are designed on paper. So in a few years after completion of the facility, these papers are not used and disappear. PR must be revised daily according to the progress of project implementation. Now, we are offering to introduce computerized PR in a Mapping CAD system, which is an electronically that does not disappear. I herad that STM has a good system.

Following telecommunication expansion, computerization of daily work, such as automatic service order processing, comes to the table for discussion.

NTT has introduced the American system called CBIS (Cincinatti Bell Information Sytem) and has found it necessary to change the existing organization even today, 3 years after its introduction, so it is an on-going situation. Actual computerization is quite different from the theory discussed at the table. Today, many developing countries are considering introduction of relatively big systems for the management of everyday work, and we always face the difficult question of how to satisfy the telecom authorities' requirements without changing the existing organization.

Outside of telecom, for example, banks are now starting to introduce the EFT system in these developing countries. The problem is how to obtain the quality circuits for computer access for bank communications. As I said previously, we are also recommending the introduction of radio systems for subscribers' use. I strongly recommend to apply this concept to the industry park where they need their own network; or I recommend the donation of the radio facilities by the industry, who has money for it, to the telecom authorities.

Finally, and the biggest point, is how to obtain appropriate human resources and how to train such scarce human resources. Generally speaking, today the governmnet salary is relatively low compared with the private sector. This makes it difficult to recruit good university graduates. In addition, when thinking of the rapid change or innovation in telecommunication facilities, the importance of obtaining such resources is quite clear, but doing so is quite difficult. Even if the resources are obtained, how to train and manage them is another big problem to be solved.

I often tend to think that the maintenance of digital switches should fully depend upon the manufacturers and that halfway organization means nothing. Or that some type of assistance program supported by ITU or The World Bank, such as centralized switch maintenance centers with training facilities, would be highly appreciated. Some of these concepts will be applied for OSP workers under the name of "OPMC Project" in Indonesia, which is supported by The World Bank.

Looking at digital switches, problems seldom occur, but once they happen, highly skilled engineering is required to fix it. So special assistance terms or manufacturer's support are indispensible.

My last visit to South East Asian countries gave me the impression that today mobile telephones are quite popular, but so many mobile telephones are installed that, as a result, dial-tone access for the mobile telephone is quite difficult to obtain. I was informed that the successful completion rate of mobile telephone calls is only around 30%. Good management between the telephone network and mobile telephone is lacking. Porduction policy is another item which must be discussed. How much do they depend on foreign manufacturers? How about optical fiber systems? How about ISDN?

At the end of my speech, I would like to propose the followings:

(1) Managing Directors should access strongly to the related government departments to make them understand the importance and difficulty of telecommunications expansion.

(2) OSP must be treated as first priority.

(3) Temporarily, radio subscriber systems should be introduced.

(4) Human resources must be well taken care of with respect to both hiring and training.

Towards the intertwinement of international society based on computer and communication hybrid network

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1. Abstract

An information network that is an integration of data processing system and telecommunication network has become indispensable for corporate activities in manufacturing, distribution, and finance sectors. It will serve as a basic tool for realizing high level of people's life and expanding corporate activities, so that the use of it will become more common.

We can enhance an information network by including participants as many as possible each of that add its original value. A rich information network, on the other hand, enriches the people's creativity. An information network society is a society that grows by mutual action of an information network that expands and people who have creativity.

2. Basic Trade in Information Network

(1) Information network providing greater opportunity for providing services

1) Technological evolution and cost reduction

2) Expansion in application of information network

Technological progress has been continuosly eliminating economical restrictions for starting new services and extending the conventional services. As data processing capability increases by e.g. the progress of artificial intelligence, the application of information network has expanded, providing greater opportunity for accommodating new services.

3) Use of information network

Technological progress so far and in the future eliminates the limitation of telecommunication as a resource to almost nothing. The key to considering conventional information networks is how to use people's creativity and how to development various usage of information networks.

(2) Network with varied, multi-layered, and multi-dimensional aspects with cooperation from

various economic bodies

1) Extension in the purpose of using information networks

The purpose of using information networks for a company has extended from merely a tool for increasing efficiency to expanding company activities. The company applications of information networks have also extended from auxiliary or routine tasks to the center of decision making.

In the future, information networks will be used by individuals for fulfilling life.

2) Multi-layered and multi-dimensional networks as means for cooperation between various service agents bodies

For an information networks to be used in different fields for various purposes, various services (data processing, database, telecommunication, and combination of these services) that fulfill people's need must be provided. To provide such services, different service agents of various characteristics must cooperate through an information network. This creates a multi-layered and multi-dimensional network.

(3) Information network responding to globalization of economy

1) Increasing in importance of international exchange of information

As economy more globalized, there is a growing importance in international exchange of information, including telecommunication between central office and overseas branches and establishing an international order sending/receiving system that encloses overseas affiliate companies.

2) Maintaining free exchange of information

The development of Japan has been depending on the free international trading system. In future when more of international economic activities will be performed using information networks, it is necessary to establish international telecommunication networks that do not hinder the exchange of information.

(4) Full-scale introduction of information network to homes

1) Full-scale introduction to homes

As living standard rises, use of information networks at homeswill become common. Spread of satellite offices and home offices because of land shortage in large cities will accelerate such a trend.

2) Competition between various agents in home services

Information network will be introduced to homes as home banking, home shopping, and home schooling systems that can clearly show the features of services.

3. What are required of information network

A basic telecommunication network serves as a fundamental infrastructure for establishing a information network. For an information network society that we have stated above to develop, a telecommunication network having the following

requirements is required.
A social system for telecommunication should help establishing such a network.

(1) Basic telecommunication service at low cost

As an information network used more, the amount of information will become tremendous. Unless the basic telecommunication cost decreases reflecting the progress of related technology, we still have the economical restrictions in using the information network. The difference of basic cost between distances limits the two-dimensionally expansion of information network and hinders the integrated use of country.

(2) Communication facility capable of transmitting information in large quantity

The future development of an information network society will require high speed and high capacity transmission of large amounts of general data and image data.
To accomplish such a transmission capability, we need to renew trunk lines and switching equipment. Use of optical fiber technology in subscriber lines is indispensable to introduce advanced an information network into private homes, strengthen the bottom line of the information oriented society in Japan.

(3) Ease of cooperation among varied service bodies

Corresponding to different user needs, for several service agents of various features to cooperate to provide information network services, the system must guarantee the free activity of service agents.

(4) Inter-operability that guarantees establishing an information network

For a large number of service agents to cooperate to provide services and for a large number of users to freely use the services, the connections between service agents and between users must be established.

(5) International communication network that facilitates information access between nations

To promote free exchange of information between nations, it is indispensable to reduce the international telecommunication rate by market competition and to improve the network by installing necessary facilities including submarine cables.
Except minimum limitations that each nation considers appropriate, the telecommunication market should be open with minimum restrictions. This will enable telecommunication networks extending throughout the world and an information networks.
For guaranteeing intelligent propriety right, security, and protection of private information, it is necessary to harmonize the related system of each nation so that the system does not hinder free exchange of information.
As a future objective, we should also consider unification of the basic telecommunication rate throughout the nation, which will contribute to the policy of integrated use of country. Such an effort requires national consensus.

Dawn of competition on the birth of a new common carrier in Japan - Pain and Joy

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January 16, 1990

Abstract

ITJ has realized all digital high-quality international telephone services enabling any user living in Japan to dial at a more competitive price than ever before. ITJ has been the leader in Japan in dissolving the difference of basic public service cost currently controversial between Japan and U. S. A. in their "Structural-Impediments Initiative Talk" and helped bring about relief from the burden of highly costly international telecommunications from Japan and made it more economical to reach U.S.A. and major countries of the world.

I am pleased to have this opportunity to explain about ITJ's efforts in becoming a new common carrier of Japan. In the first half, I wish to report to you that ITJ started its international switched telephone services on October 1, 1989 or only 3 months ago and explain what has been achieved. In the second, I wish to speak about what ITJ is doing and what ITJ is trying to do.

The Japan Economic Journal or The Nihon Keizai Shinbun in its issue of November 22, 1989 reported the comparison of long distance telephone charges in the United States and in Japan. You can call from Washington D.C. to San Francisco, that is about 4,500KM, at 26 cents for one minute using AT&T service. In Japan using the service of NTT who is our dominant domestic carrier, at the same cost your call from Tokyo can reach only 80KM.

This comparison indicates how exorbitant our long distance telephone call in Japan is. This is a typical example of controversial public service costs that exist in Japan. In parallel with domestic telephone services which used to be for a long time NTT's monopoly market, international telecommunications has been served by KDD, another monopoly in international telephone services. KDD made repeated reductions of its tariffs but many large users of international telephone services always had frustration because telephone call from Japan to U.S.A. or other foreign countries was tariffed more expensively compared with telephone call from U.S.A. or other countries to Japan.

Seven major users of international telecommunications in Japan agreed to together form a new carrier in order to serve the needs of users following the introduction of new Telecommunications Business Law of Japan in 1985. 137 shareholders, all large corporate users of international telecommunications operating in Japan supported the start of ITJ. On April 1, 1989, ITJ started its Private Leased Circuit Services and on October 1, 1989 it started switched telephone services between U.S.A. and Japan.

New York Times of October 2, 1989 reported with a heading "Japan Price war Begins On Foreign Phone Calls" and quoted as follows:

"Now the race to attract customers is on. When Service Started this morning, a three-minute call to the United States ranged from less than $3 to about $4.85, depending on the time of day. KDD's prime-time rate is $6.35, though it was forced to announce the major cut last week that will take effect in a month. By comparison, AT&T charges $6.02 for a prime-time three minute call, and $3.78 for its least costly call."

ITJ has successfully broken the wall that always existed and kept the cost of telephone call from Japan to U.S.A. more expensive than a call from U.S.A. to Japan. ITJ's entry with new tariff rates was followed within one month by KDD's reduction of their tariff which was quite substantial and as a result KDD's prime time rate 3 minutes call has become $5.10 and $3.07 for its least costly call.

In the second part of my presentation, I wish to explain about what ITJ is doing and also what ITJ is trying to achieve.

ITJ has almost completed to build its facilities. Government license for Type I common carrier requires us to own basic facilities for the telecommunications operations. We built a Telecom center in Tokyo where international gateway switch is installed, two earth stations in Chiba and Yamaguchi for operation with two INTELSAT satellites of POR and IOR, sub-center in Tokyo for the purposes of concentrations of PLC. Local lines to users in metropolitan areas and all the facilities are in operation. We will complete another telecom center in Osaka in March this year and when it is fully tested we hope to move to the next step of operating with two switching centers in Tokyo and Osaka. We already own or are committed to own capacities in major optical fiber cables such as HAW-4-TPC-3, TPC-4, H-J-K, G-P-T, PacRim Cables and ASEAN cables and acquired IRU of TAT-9 and other various already built analog cables.

As of today, there are only 6 countries with whom we are operating switched telephone services, namely U.S.A., Singapore, Hong Kong, U.K., France and Taiwan. We have about 10 more countries with whom we have agreed and are working together for early implementation of telephone services. There are some other countries with whom we are discussing in order to reach agreements. By the end of October 1990 we hope to operate with more than 20 countries.

Many people compare us with the cases of new entry by MCII, US Sprint in U.S.A., and MCL in U.K. In Japan users do not need to register, contract with us or spend any money for any additional terminals. They can simply dial 0041 from their home telephone and can select ITJ services. This is quite an advantage over the cases of the three afore-mentioned carriers.

New York Times of October 2, 1989 which I already referred to, described this situation as follows:

"In Japan, consumers vote every time they pick up the telephone."

If I add a little more explanation, when you dial 0041 instead of traditional 001 (KDD), you get ITJ. It's very simple! This can work to a great advantage for ITJ. However, it also means that ITJ users are not "locked in". If people tried ITJ and found the quality unsatisfactory, they will go back to KDD. This is the reason why ITJ places its prime importance on maintaining its quality. How do we achieve it? Full digitalization is the key to this answer. All ITJ's facilities and equipments are brand new and digital. Every interface within each ITJ's station, inter ITJ's stations is digital. Full digitalization is also a major contributing factor to make ITJ competitive in its challenge for a high quality and less expensive operation because ITJ successfully avoided dual investment in analog/digital facilities and minimized operational cost as well.

In order to keep our operational cost competitive, ITJ started its telephone services with a narrow range of menu. Our services are basically International Direct Dialing (IDD) with limited operator assisted services for a few exceptional cases. ITJ do not handle Telegraph or telex. In spite of these handicap obvious to public, we are receiving very positive response from users in Japan.

ITJ's major strength is its marketing capability among large number of business users of international telephone services which include most of our shareholders. As the number of Japanese people travelling abroad increases, the international telephone call by individuals is rapidly increasing. ITJ has a sure feeling that both business and individuals are supporting, encouraging the new entry of ITJ.

Session 4.1

VSAT Technology and Applications

NOTES

Demonstration of a Low-Cost Tracking Mechanism for C-Band VSAT Applications

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1. Abstract

A low cost tracking antenna system to allow C-band VSATs to operate with inclined-orbit satellites has been developed by COMSAT Laboratories. A successful demonstration of the tracking ability of the system was completed at Paumalu, Hawaii as part of the PEACESAT test and demonstration. The system operates as an open loop program tracker. By the unique mount design, the tracking motion is limited to only one axis of movement. This tracking system could be inexpensively manufactured in small quantities. The actuator and controller equipment are commercially available through TVRO distributors.

2. Introduction

This paper presents the results and conclusions of a test and demonstration of two C-band VSATs equipped with low-cost tracking mechanisms. These VSATs, with antenna diameters of 1.8 and 2.9 meters, respectively, operated in an INTELSAT VISTA-like Star Network with the Paumalu-1 Standard A earth station acting as Hub. All three earth stations simultaneously tracked the inclined orbit INTELSAT IV-A F-3 at 177°E, whose daily north-south inclination was ±2.9°. The test and demonstration, jointly sponsored by COMSAT and INTELSAT, was conducted by COMSAT during the week of July 25, 1987 at the Paumalu earth station site in Hawaii.

3. Demonstration Objectives

The objectives of the test and demonstration were to:

1) demonstrate the feasibility of tracking an inclined-orbit INTELSAT satellite with C-band VSATs; and

2) convince the PEACESAT (1) organization and others that the INTELSAT system would be a viable replacement satellite system for the PEACESAT network (2).

4. Test Configuration

Figure 1 depicts the test configuration for the PEACESAT test and demonstration. As shown in that figure, three earth stations, all located at the Paumalu site on the island of Oahu in Hawaii (3), tracked the inclined-orbit INTELSAT IV-A F-3 satellite at 177°E, whose daily north-south inclination drift during the test was ±2.9°. The Paumalu-1 Standard A earth station (PAU-1A) and the COMGEN 2.9 meter VSAT (FLY-2G) are registered, licensed INTELSAT earth stations.

The COMGEN 1.8 meter VSAT is non-standard. The half-power beamwidths of the two antennas are 1.2° and 1.9°, for the 2.9 meter and 1.8 meter VSATS, respectively.

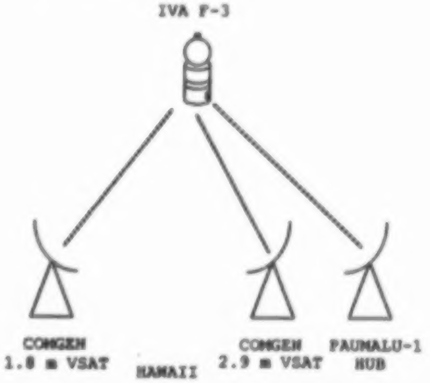

FIGURE 1. TEST CONFIGURATION FOR THE PEACESAT TEST AND DEMONSTRATION

The C-band VSATs used in the test were modified versions of flyaway Ku-band VSATs normally used by COMGEN to support U.S. Executive Branch communications from remote locations. The VSATs were modified for C-band operation and, in addition, retrofitted by COMSAT Laboratories with low-cost TVRO "Satellite Positioners" and associated electronics to automatically perform the adjustments necessary for tracking inclined-orbit satellites. (See the appendix for a complete description of the single-axis tracking mechanism designed and developed by the Earth Terminal Antenna Department of COMSAT Laboratories).

The C-band VSATs were in effect mock-ups or models of low-cost C-band VSATs of interest to the PEACESAT organization. For example, the C-band VSATs used Travelling Wave Tube Amplifiers

(TWTAs) and not the more efficient and compact Solid State Power Amplifiers (SSPAs). Further, the C-band VSATs used transportable tripod mounts, which would not be necessary in an actual PEACESAT network application.

Figure 2 shows a functional block diagram for the earth segment portion of the test configuration. As shown in that figure, the C-band VSATs were equipped with a single voice/data circuit capability, each using a 64 Kbps Bi-Phase Shift Keying (BPSK) modulator/demodulator (MODEM). The Paumalu Hub station was equipped with two such MODEMs to perform the necessary "turn-around" function. The choice of the BPSK MODEMs was dictated by equipment availability and by the fact that BPSK is better suited than the more common QPSK for remote, tropical networks employing VSATs, such as the PEACESAT network.

Figure 3 provides a transmission plan diagram of the four SCPC/BPSK carriers used to establish the communications link between the 1.8 meter VSAT and the 2.9 meter VSAT. As shown in that figure, two carriers establish the "go" link from the 1.8 meter VSAT to the Hub and from the Hub to the 2.9 meter VSAT, and two carriers establish the "return" link from the 2.9 meter VSAT to the Hub and from the Hub to the 1.8 meter VSAT. The use of a Hub to turn-around signals from VSATs saves significant VSAT transmitter power and cost.

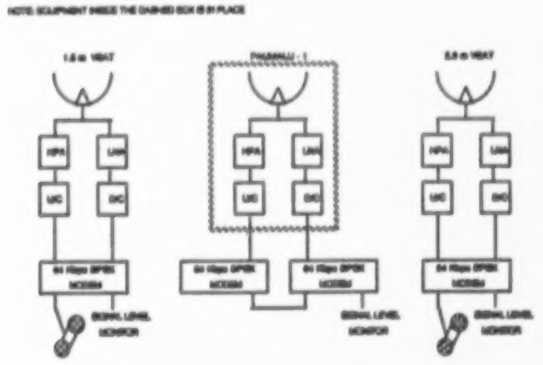

FIGURE 2. FUNCTIONAL BLOCK DIAGRAM FOR THE PEACESAT TEST AND DEMONSTRATION

5. Test and Demonstration Results

The test and demonstration consisted of 1) a presentation of INTELSAT system-related information to members of the PEACESAT organization, including a demonstration of the quality of the satellite communications link and 2) a technical verification of the VSAT tracking mechanism.

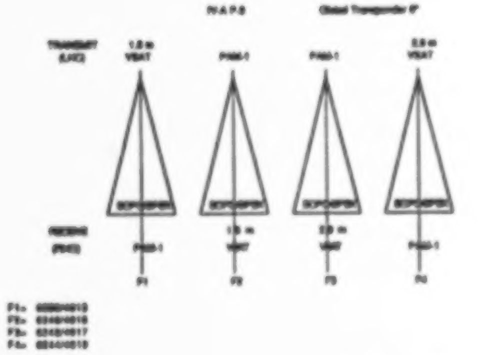

FIGURE 3. TRANSMISSION PLAN FOR THE PEACESAT TEST AND DEMONSTRATION

Verifying the accuracy of the tracking mechanisms developed for the VSATs was accomplished by monitoring and recording the transmitted signals using telemetry receivers installed at the Paumalu site. Both the Paumalu-1 Standard A earth station and the 2.9 meter VSAT were monitored and recorded. The Paumalu-1 earth station, which is equipped with a closed-loop (beacon monitoring) auto-track system in full compliance with INTELSAT Standard A specifications, served as the reference with which to compare the 2.9 meter VSAT single-axis tracking mechanism. As shown in the strip-chart recording of Figure 4, the signals received by the 2.9 meter VSAT varied at most by 1.5 dB relative to the reference signal transmitted by the Paumalu-1 earth station over the course of a 24 hour period. This implies a system positioning accuracy of about ±.04°, since the 2.9 meter VSAT 3dB beamwidth is 1.2°. The measurements were taken over a ten-day time span, and the 24 hour period shown in Figure 4 was typical of the ten-day measurement period. The 2.9 meter VSAT signal variation showed the expected sawtooth pattern corresponding to the "Satellite Positioner" corrections which were automatically programmed to occur every half hour. The 1.8 meter VSAT signal was not monitored; however, the signal variation introduced by the tracking mechanism could be expected to be less than that for the 2.9 meter VSAT.

6. Conclusions

All aspects of the PEACESAT test and demonstration were considered to be successful. Members of the PEACESAT organization were exposed first hand to C-band VSAT technology, and gained an understanding of the INTELSAT system and its capabilities that would not have been possible without the test and demonstration. Moreover, as the test results showed, the COMSAT Laboratories tracking mechanism performed as expected, indicating that it could be considered for widespread use in C-band VSAT networks accessing inclined-orbit satellites.

7. Acknowledgement

The test and demonstration was the result of a collective effort between INTELSAT and three divisions within the COMSAT Corporation. COMSAT's World Systems Division, INTELSAT Satellite Services's (U.S. Signatory to INTELSAT) served as overall project coordinator and donated the facilities at the Paumalu site, including the Paumalu Standard A earth station. COMSAT General, a subsidiary of COMSAT's Systems Division, donated the VSATs. COMSAT Laboratories designed, developed and retrofitted the COMGEN VSATs with low-cost tracking mechanisms, and provided technical services at the Paumalu site during the test and demonstration, including set-up and overall monitoring and testing.

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(1) Pan-Pacific Education And Communications Experiments by Satellite

(2) A network of some hundred low-cost UHF earth stations with access to the ATS-1 satellite providing limited voice/data communications to remote geographically dispersed locations throughout the Pacific Basin.

(3) The nominal coordinates for the Paumalu site are 202° 58' 43" East, 21° 40' 26" North

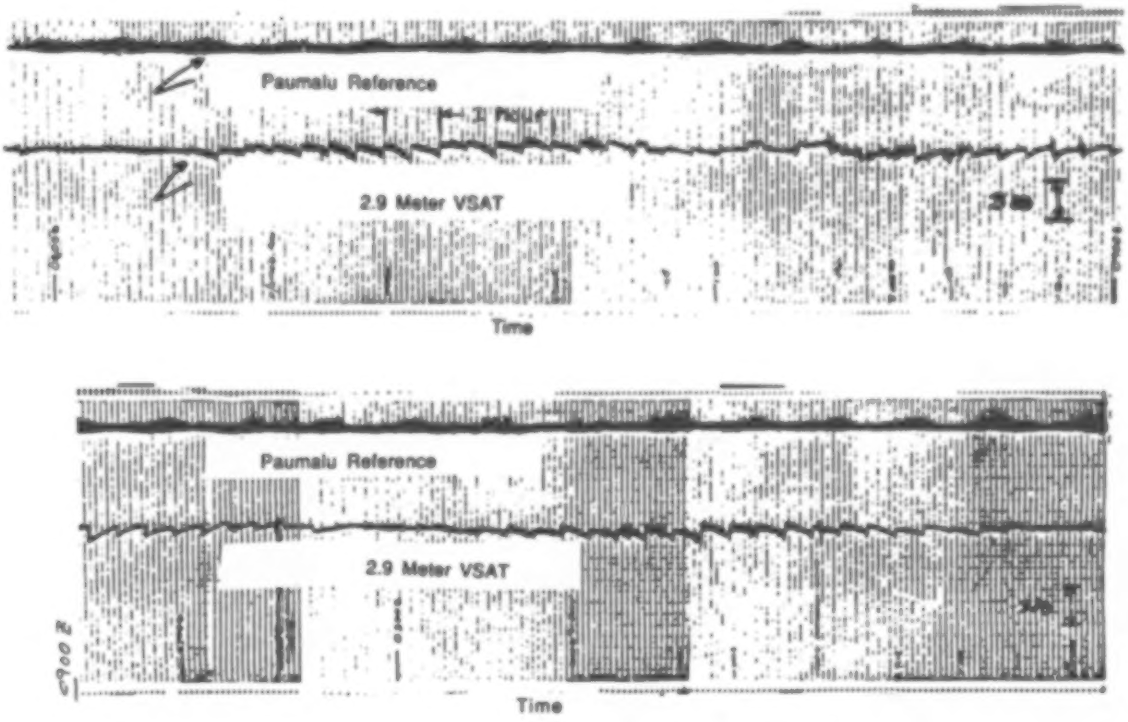

FIGURE 4. TRACKING ERROR OF THE 2.9 METER VSAT

Appendix

LOW COST TRACKING ANTENNA SYSTEM FOR VERY SMALL APERTURE TERMINALS

1. Introduction

Two-tracking antenna systems were designed and developed by the Earth Station Antenna Department of COMSAT Laboratories for the PEACESAT test and demonstration; one system for the 2.9 meter VSAT and the other for the 1.8 meter VSAT. Both systems are of the same design, they differ only in size. Although tracking antenna systems are commonplace, the ones currently available from earth station vendors are expensive and are generally only available for large size earth stations (antenna reflector diameters larger than 5 meters). A major design goal was to develop an inexpensive tracking system suitable for use in the PEACESAT test and demonstration and also with other small, low-cost C-band VSAT earth stations (antenna reflector diameters less than 5 meters). The following provides a description of the tracking antenna system, including a description of the procedure for aligning the system to track an inclined-orbit satellite.

2. Description of the COMSAT Laboratory Antenna Tracking System

Figure A-1 provides a functional, not-to-scale sketch of the COMSAT Laboratory antenna tracking system. As shown in that figure, the antenna tracking system consists of an antenna mount, antenna positioner or actuator and a timer. Functionally, the system would be the same for all antenna reflector sizes, only the size of the antenna mount and positioner would change with antenna reflector size. The antenna mount consists of an azimuth adjustment table mounted on a tripod (1). The azimuth adjustment table consists of two solid disks separated by a thin friction reducing plastic sheet to facilitate azimuthal rotation of the upper disk relative to the lower disk, which is rigidly mounted to the tripod. Once the azimuthal position is determined, the upper disk is clamped to the lower disk by a clamp/nut system at the outer circumference of the upper disk.

Attached to the back surface of the antenna reflector is a long cylindrical tube which can be rigidly fixed to the upper disk of the azimuth table by two horseshoe clamps. The clamps are tightened after the cylindrical tube is rotated to the proper tilt angle. The cylindrical tube is fixed to the back surface of the antenna reflector by a hinge which allows the antenna reflector to be rotated up or down about the hinge axis to the proper pointing angle, which is controlled by the positioner.

The positioner consists of an actuator arm which is a motor-driven jack-screw device, and a controller. The actuator arm is permanently fixed between the top edge of the antenna reflector and the back end of the cylindrical tube. The actuator arm is commanded by the controller to push or pull on the top edge of the antenna reflector to achieve the desired pointing angle.

The timer provides signals to the controller to command the actuator arm to adjust the antenna reflector to track an inclined-orbit satellite. In essence, the timer keys the antenna reflector to point in the direction of the satellite and to follow its daily movement.

A picture of the antenna tracking system designed for this application is shown in Figure A-2. The system is designed such that the antenna reflector pivots around the fixed axis of the hinge and traces an arc in the sky in both azimuth and elevation coordinates. This system matches the arc traced by the antenna reflector to the motion of the inclined-orbit satellite. Significantly, this system does not trace the well-known "figure-8" pattern of an inclined-orbit satellite, as do auto-track systems associated with large-size earth stations. Rather, it traces an arc that bisects the middle of the "figure-8" pattern. A system such as this is suitable for VSATs where the antenna beamwidths are large enough to encompass the movements of a satellite in inclined-orbit. This system is an "open-loop" or "passive" tracking system, that is, it does not detect and monitor a beacon signal radiated from the satellite. The controller stores the satellite positions and activates the actuator to point the VSAT antenna.

The COMSAT Laboratory antenna tracking system bears a resemblance to the common backyard TVRO application, for which the positioner was in fact originally developed. In the COMSAT Laboratory system the actuator arm pushes or pulls on the top edge of the antenna reflector to trace an arc orthogonal to the equatorial arc, whereas in the typical TVRO setup, the actuator arm moves the antenna to trace a path along the equatorial arc. In the TVRO situation, the positioner allows the home user to select by way of the controller any satellite along the equatorial arc. The home user pushes buttons on the controller which have been preprogrammed to command the actuator arm to move the antenna reflector a predetermined amount so that antenna reflector is directed toward the desired satellite.

The positioner used in the COMSAT Laboratory antenna tracking system was a Tracker III antenna positioner manufactured by Houston Tracker Systems, Inc. To date, hundreds of thousands of these units have been sold throughout North America for backyard TVRO applications.

3. Aligning the System to Track an Inclined-Orbit Satellite

Aligning a VSAT equipped with the COMSAT tracking antenna system requires an a priori calculation of the azimuth, tilt and pointing angles (θ, δ and ϕ depicted in Figure A-1). These angles are calculated on the basis of known information - satellite position (longitude) and north-south inclination drift, and VSAT location (longitude and latitude).

The first adjustment is the setting of the azimuth angle, which is accomplished by turning the top disk of the azimuth adjustment table to the calculated azimuth angle and then clamping the top disk to the lower disk. The azimuth angle is calculated relative to true North, which can be determined by a compass.

The next and most important setting is the tilt angle (S). For a fixed tilt angle, movement of the actuator arm causes the antenna pointing vector to trace out a curve in both azimuth and elevation coordinates. From the family of curves possible for all tilt angle valves, a single curve that fits the predicted satellite azimuth and elevation movement is calculated. Using this data, the pointing angle (O) and the corresponding actuator arm lengths for a given mount geometry are also determined. Thus, both the tilt angle and the pointing angles (actuator arm lengths) are known that best match the predicted track of the satellite. The antenna reflector is now ready to be pointed toward the satellite at a specified date and time, and thereafter follow its daily movements; all that is needed is timing information.

A timer to interface with the controller was developed to drive the actuator at specific time intervals during the day. The north-south movement of an inclined-orbit satellite is sinusoidal with a period equal to one sidereal day (2). Breaking the sine curve up into equal portions of time produces a plot which shows the satellite moving faster through the middle portion of the curve and slower at the endpoints. Moving the antenna in equal increments of sidereal time allows the same position to be used to track the satellite on its northward and southward drift during each half of the sidereal day.

The Tracker III positioner has the ability to store 24 satellite positions in memory. A sidereal crystal time base supplied by Gemini Astronomical Time Instruments was used to trigger the controller and in turn the actuator arm to change positions each sidereal half hour. This gives a total of 48 positions during a sidereal day (each memory location was used twice).

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(1) A collapsible tripod was selected for the PEACESAT test and demonstration to facilitate transportability. However, in a permanent installation, alternative rigid support structures, such as a cement imbedded pole mount, would be a lower cost solution.

(2) A sidereal day is the time it takes for the earth to make one revolution relative to the vernal equinox and is shorter than a 24 hour solar day by about 4 minutes.

384

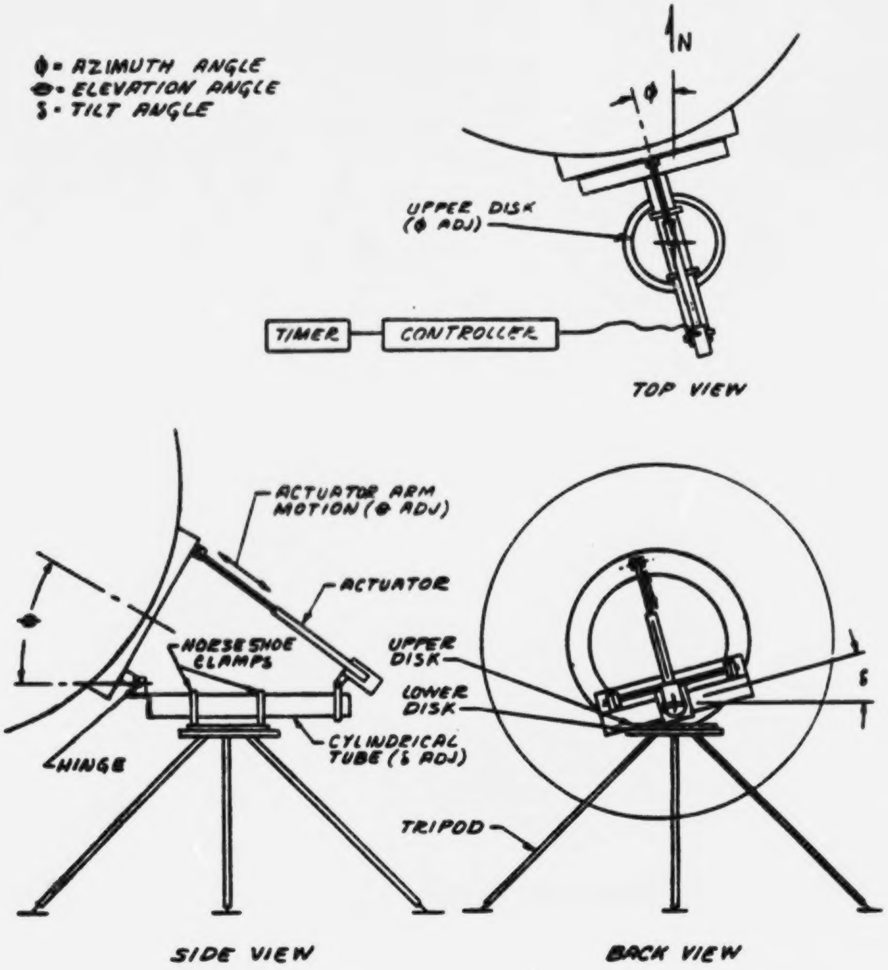
ϕ = AZIMUTH ANGLE
θ = ELEVATION ANGLE
δ = TILT ANGLE
N
ϕ
UPPER DISK
(ϕ ADJ)
TIMER
CONTROLLER
TOP VIEW
ACTUATOR ARM
MOTION (θ ADJ)
ACTUATOR
θ
HORSESHOE
CLAMPS
CYLINDRICAL
TUBE (δ ADJ)
HINGE
UPPER
DISK
LOWER
DISK
δ
TRIPOD
SIDE VIEW
BACK VIEW

FIGURE A-1. FUNCTIONAL SKETCH OF THE COMSAT LABORATORY TRACKING ANTENNA SYSTEM

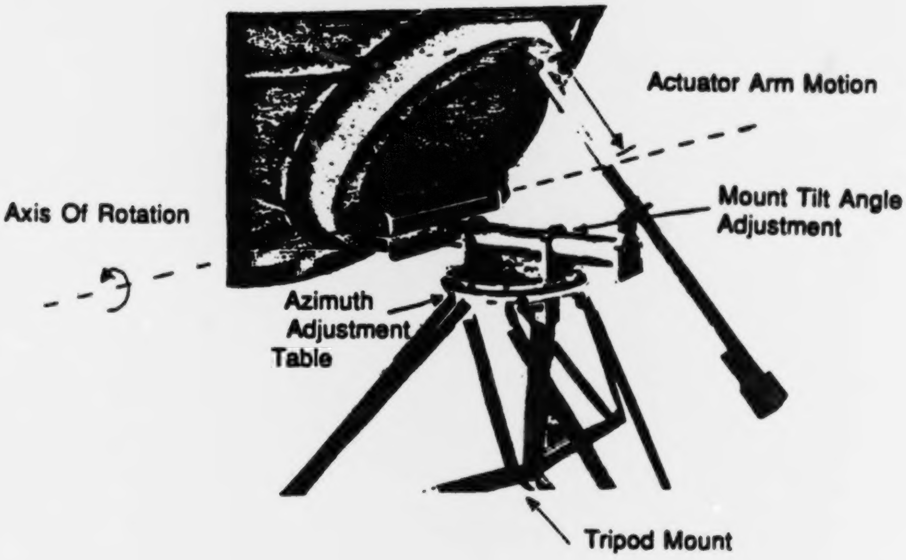
Actuator Arm Motion
Mount Tilt Angle Adjustment
Axis Of Rotation
Azimuth Adjustment Table
Tripod Mount

FIGURE A-2. PICTURE OF THE COMSAT LABORATORY ANTENNA TRACKING SYSTEM

C-BAND VSAT NETWORKING

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Hughes Networks Systems, Inc.
Germantown, Maryland, U.S.A.

1.0 ABSTRACT

This paper describes C-band VSAT network applications, network architecture, and system elements. These networks are ideally suited to developing countries where only C-band resources are available and interference with terrestrial microwave systems is not a problem, and where terrestrial circuits are poor or nonexistent.

2.0 INTRODUCTION

Satellite-based Very Small Aperture Terminal (VSAT) networks using on-premises earth stations have emerged as the bypass technology alternative to terrestrial networks in providing integrated data, voice, and video communications. The star topology of the VSAT network makes them ideally suited to point-to-multipoint communications such as banks, retail stores, and auto dealers. In these applications they are used to provide credit card verification, inventory control, Point of Sale (POS) support and video training. **Figure 1** represents the traditional terrestrial communications network utilizing modems and telephone lines to transfer data between the central host computer and the remote end users. The advantages of a VSAT network over a terrestrial network include higher availability, distance insensitivity, configuration flexibility, rapid deployment, lower and stable costs, centralized network management and control, broadband broadcast video, and more. The throughput and response time performance of VSAT networks generally exceeds that of terrestrial networks.

The evolution of C-band VSAT terminals has been an integral part of the total evolution of satellite communications technology. Ku-band VSATs are very popular in developed countries; however, due to the proliferation of microwave systems in the 4 GHz to 6 GHz band, the original C-band VSATs were developed using Spread Spectrum technology. In general, the performance of Spread Spectrum technology VSATs is considerably inferior to that of the high capacity Ku-band VSAT terminals.

One company, Hughes Network Systems, Inc. (HNS), is marketing a C-band VSAT mainly for developing countries where microwave interference is not a limiting factor and C-band satellite resources are widely available and preferable. The HNS C-band VSAT (known as the C-band Personal Earth Station™ (PES™)) is identical in performance to that of its Ku-band PES.

3.0 NETWORK ARCHITECTURE

The VSAT network architecture is a star topology, as shown in **Figure 2**. It consists of a central hub station communicating with the remote stations on a broadcast (one-to-many) basis by using a high capacity continuous Time Division Multiplexed (TDM) carrier signal. Outbound messages from the hub to the remotes are concatenated onto this carrier. Each remote receives the outbound TDM signal and derives its timing reference from it. In addition, each remote extracts data packets by looking at this outbound TDM signal and filtering out all packets but those addressed to it. Software configurable parameters define each remote's address and ensure delivery of addressed data packets to the correct remote.

The remotes, on the other hand, communicate with the hub on a shared (multipoint-to-point) basis by using burst transmissions over distinct Time Division Multiple Access (TDMA) carriers. This sharing procedure can be on a preassigned, demand-assigned, or random access basis. A network is generally defined as one TDM (or outroute) carrier and one or more TDMA (inroute) carriers. See **Figure 3**. The network is composed of multiple remote station VSATs, a central hub station, and a network management computer. The hub interfaces with the host computer, and the VSATs interface with the remote users terminals. See **Figure 4**. Remote-to-remote voice communication is possible via a double hop through the central hub station.

3.1 OUTROUTE AND INROUTE FORMATS

Outroute:

Typically the outroute is a continuous TDM carrier consisting of concatenated variable length packets received from the host computer through the hub ports. The packets are arranged into frames and superframes. A superframe contains a superframe header packet that is used for network synchronization. Each remote monitors this outroute and picks out only those packets addressed to it. The outroute transmission rate can vary, depending upon manufacturer, from 56 kbps to 512 kbps. Most VSAT manufacturers utilize Rate 1/2 Forward Error Correction (FEC) to conserve satellite power and improve performance.

Inroute:

The inroute in the TDMA method is composed of multiple VSATs transmitting bursts at different times on the same inbound carrier. This inbound carrier is divided into frames, and each frame is further divided into an integral number of slots. A burst is an integral number of slots long. The inroute transmission rate can vary, depending upon manufacturer, from 56 kbps to 128 kbps. Typically the VSATs can use the following access methods that are chosen depending upon which one is best suited to the application.

- **Random Access (Slotted Aloha)** - This method is ideal for interactive random type of traffic, such as Point of Sale (POS) terminals and bank Automatic Teller Machines (ATMs). It provides very good response time performance; however, its space segment efficiency is low due to a theoretical maximum of 36.8% (1/e) and a practical maximum of 10% to 15%. Typically slotted Aloha is implemented using 4% or 5% utilization to avoid collisions and improve response time performance.

- **Demand Assignment (Transaction Reservation)** - A remote transmits its traffic after making a request and receiving authorization from the hub, if inroute bandwidth exists. This method provides maximum space segment efficiency but a slower response time as compared to slotted Aloha. This method is ideal for interactive and wildly varying message size data traffic.

- **Dedicated or Preassigned (Stream)** - In this method, a remote is provided dedicated inroute bandwidth. This method provides very good response time performance because bandwidth is always available for transmission, unlike slotted Aloha and transaction reservation. However, its space segment efficiency is lower because bandwidth is always allocated whether or not there is data to transmit.

Because each manufacturer uses various transmission rates, burst formats, and proprietary satellite link protocols, VSAT networks from different manufacturers are not compatible.

4.0 VSAT NETWORK APPLICATIONS

VSAT networks are being utilized in many different strategic applications around the world. These applications benefit from VSAT's performance, features, flexibility, cost and ease of configuration. Bypassing the traditional terrestrial network increases reliability because multiple carriers are eliminated. In addition, because the customer owns the VSAT network, costs can be projected into the future without fear of tariff increases. The VSAT network's star topology is ideally suited for an unlimited number of applications, some of which are listed below.

- **Retail Sales** - Credit verification, inventory control, online order processing, broadcast video for sales training and promotions, voice communications

- **Hotel and Motel** - Room reservations, hotel management, broadcast video

- **Remote Communications/Energy Management** - SCADA, remote control, data collection, telemetry, voice, emergency communication, and monitoring of oil wells and pipelines

- **Banks/Financial** - ATM, account information, electronic funds transfer, broadcast video, electronic mail, data security, image transmission, financial data transfer

- **Auto Dealership** - Parts ordering, vehicle locating, dealer communications, video training, sales and promotion, document delivery, manufacturing, image transmission

- **Health** - Image transmission, emergency communication

- **Business Television** - Product announcement, sales and training, corporate communications, video marketing

- **Brokerage/Investments** - Stock quotation, accounts control, business promotion

- **Emergency Communications** - Rapid deployment in natural disasters such as forest fires, earthquakes, hurricanes, tornados

5.0 VSAT NETWORK COMPONENTS

As shown in **Figure 4**, the VSAT network consists of four major components.

- Remote stations
- Central hub station
- The Network Management Center (NMC)
- Space link

5.1 REMOTE STATION

The HNS C-band PES, as shown in **Figure 5**, consists of two major components: the Outdoor Unit (ODU) and the Indoor Unit (IDU).

The ODU consists of an offset feed antenna (1.8 meter or 2.4 meter) and the C-band Outdoor Electronics (ODE) mounted at the feed as shown in **Figure 7**. The ODE consists of C-band up/downconverters, a monitor and control unit, 3.4 W Solid State Power Amplifier (SSPA), Low Noise Amplifier (LNA), and a power regulator. The feed system can be linear crosspol or copol, depending upon the satellite. A circular polarizer is added to the feed system for VSAT networks operating on Intelsat satellites.

The IDU performs modulation/demodulation, coding/decoding, and inroute/outroute space link access. In addition, the IDU provides various customer DTE data interfaces and protocols, monitor and control, and remote terminal synchronization. A full transponder video output (950 MHz to 1450 MHz) is provided for analog TV reception. The HNS C-band VSAT is a bus architecture design that allows multiple remote ports equal access to the space link. In the HNS C-band VSAT up to 120 port interfaces can be provided; however, a requirement for that many interfaces at one remote location would be rare for any application. The user device can be a data terminal, a cluster controller, or a telephone handset. To ensure error-free transmission over the satellite link, HNS employs a proprietary link level protocol, known as Optimum Data Link Control (ODLC).

5.2 HUB STATION

Figure 6 shows the block diagram and signal flow for a typical hub station. The central hub station consists of a 9 to 15 meter antenna (depending upon the satellite coverage), redundant RF equipment, and IF and baseband equipment. An optional video encoder and exciter can be connected to the RF equipment for analog TV transmission, if desired. The RF equipment consists of up/downconverters, C-band High Power Amplifier (HPA), LNA, cables, and other hardware.

The hub IF and baseband equipment consists of an outroute TDM modulator (redundant), burst mode inroute demodulators, network operation and control equipment (redundant), and hub ports for data and voice. The hub IF and baseband equipment interfaces with the host Front End Processor (FEP), telephone switch, and NMC, as shown in Figure 6.

5.3 NETWORK MANAGEMENT CENTER (NMC)

The NMC performs a variety of functions such as system configuration, network control, downline loading of software to the remotes, health and status monitoring, event reporting, detailed statistics, remote commissioning, and network security functions. It typically consists of a mini-microcomputer that stores network configurations in databases and other peripherals such as a printer for event reporting, a hard disk to log statistics and event information, and a network operator console. Typically the network operator's console is a user-friendly, menu-driven console, which provides visual as well as audible network status indicators. All configuration software is downline loaded from the NMC to the various hub and remote components. This software capability allows the network operator to configure the VSAT network quickly and easily from the hub.

5.4 SPACE LINK

Typical space link parameters for C-band networks are provided in Table 1. The user protocols supported by the HNS VSAT system are given in Table 2. The user interfaces supported are shown in Table 3.

6.0 TYPICAL C-BAND VSAT NETWORKS

Hughes Network Systems, Inc. is in the process of implementing several C-band VSAT networks, such as a private VSAT network for Itau Bank (the second largest bank in Brazil), a public VSAT network for Beijing Telecommunications Authority in the People's Republic of China, and a shared hub VSAT network for IMPSAT in Argentina. The Itau Bank network is described to illustrate why a customer decides to use VSAT technology.

The Itau Bank's C-band VSAT network configuration is shown in Figure 9. It consists of a 9 meter hub station located at the bank's central data processing facility in Sao Paulo and approximately 600 1.8 meter VSAT stations at branch offices throughout Brazil. Some of the applications running on the network include ATM traffic, batch traffic, and database query traffic. To support these applications and to provide additional capacity for growth, the network uses three different host processors: IBM, Itautec, and Comten.

The VSAT network is designed to replace an existing terrestrial network that is of substandard quality, unreliable, and extremely expensive. Itau was suffering from constant tariff increases beyond their control. In addition, some branch locations have no means of communication and use pouches on mules to carry the transactions to the regional banking centers. In Brazil, it sometimes takes several months to get a terrestrial link installed, whereas the VSAT can be installed in a matter of hours.

To eliminate these problems, Itau has contracted with HNS for a dedicated C-band VSAT network that provides an integrated solution and allows Itau to have centralized control over their network. This high capacity VSAT network will allow Itau to migrate from a point-to-point Binary Synchronous Communication (BSC) network to multipoint Synchronous Data Link Control (SDLC) network. Because the HNS VSAT network is software driven, this can be accomplished via the hub operator's console as the network is deployed. As a result, Itau will enjoy lower costs, better performance, reliability, and being able to offer new and improved services.

Table 1. Space Link Parameters

Parameter	Actual/Typical Value
Transmit frequency	5.925 to 6.425 GHz
Receive frequency	3.7 to 4.2 GHz
Outroute frequency step size	500 kHz
Inroute frequency step size	100 kHz
Satellite transponder	C-band domestic or international
Polarization	Linear (crosspol, co-pol) or circular
Uplink path loss	200 dB
Downlink path loss	196.5 dB
Outroute rate	512/128 kbps
Inroute rate	128/64 kbps
Coding rate	R 1/2 FEC
VSAT antenna	1.8 m/ 2.4 m
SSPA	3.4 W
G/T	14.0 dB/K
Space link protocol	ODLC
Access methods	Random (slotted Aloha) Demand assignment (Transaction reservation) Preassignment (stream)

Table 2. User Protocols

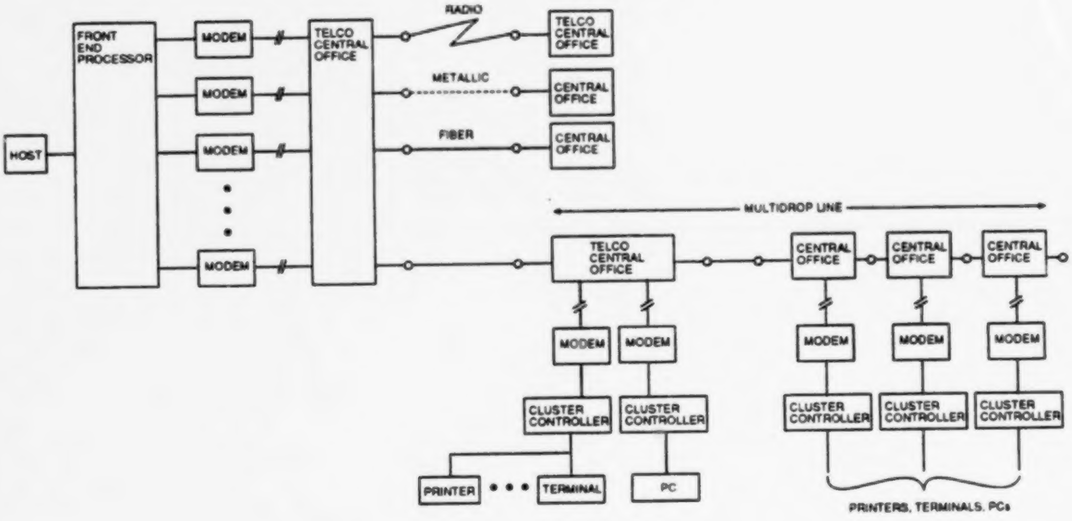
SDLC
BSC 3270
HASP
Transparent
Burroughs Poll/Select
X.25
TINET
DDCMP
Asynchronous
Specialized protocols

389

Table 3. User Interfaces

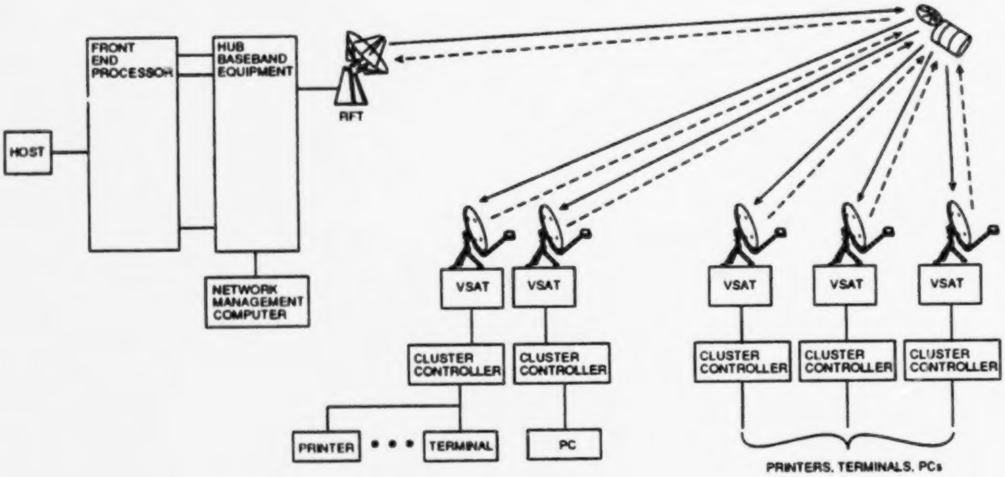
The user device can be a data terminal, a cluster controller, or a telephone handset, using any of the following interfaces:

RS-232C
V.35
RS-449
Two-wire or four-wire for voice



HOST
FRONT END PROCESSOR
MODEM
MODEM
MODEM
MODEM
TELCO CENTRAL OFFICE
RADIO
METALLIC
FIBER
TELCO CENTRAL OFFICE
CENTRAL OFFICE
CENTRAL OFFICE
MULTIDROP LINE
TELCO CENTRAL OFFICE
CENTRAL OFFICE
CENTRAL OFFICE
CENTRAL OFFICE
MODEM
MODEM
MODEM
MODEM
MODEM
CLUSTER CONTROLLER
CLUSTER CONTROLLER
CLUSTER CONTROLLER
CLUSTER CONTROLLER
CLUSTER CONTROLLER
PRINTER
TERMINAL
PC
PRINTERS, TERMINALS, PCs

Figure 1. Data Terrestrial Communications Environment



HOST
FRONT END PROCESSOR
HUB BASEBAND EQUIPMENT
RFT
NETWORK MANAGEMENT COMPUTER
VSAT
VSAT
VSAT
VSAT
VSAT
CLUSTER CONTROLLER
CLUSTER CONTROLLER
CLUSTER CONTROLLER
CLUSTER CONTROLLER
CLUSTER CONTROLLER
PRINTER
TERMINAL
PC
PRINTERS, TERMINALS, PCs

Figure 2. VSAT Data Communications Network

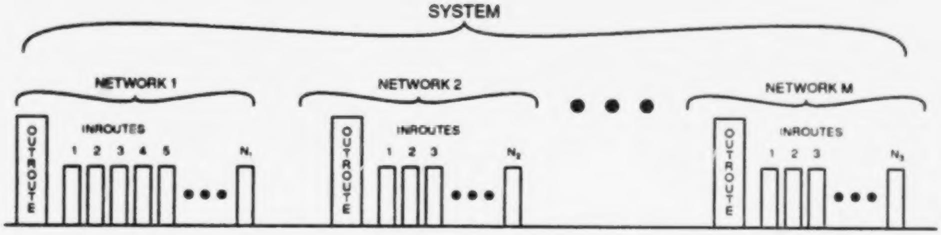

SYSTEM
NETWORK 1
NETWORK 2
NETWORK M
OUTROUTE
INROUTES
1 2 3 4 5
N_1
1 2 3
N_2
N_3

Figure 3. VSAT Network Outroute and Inroute Frequency Configuration

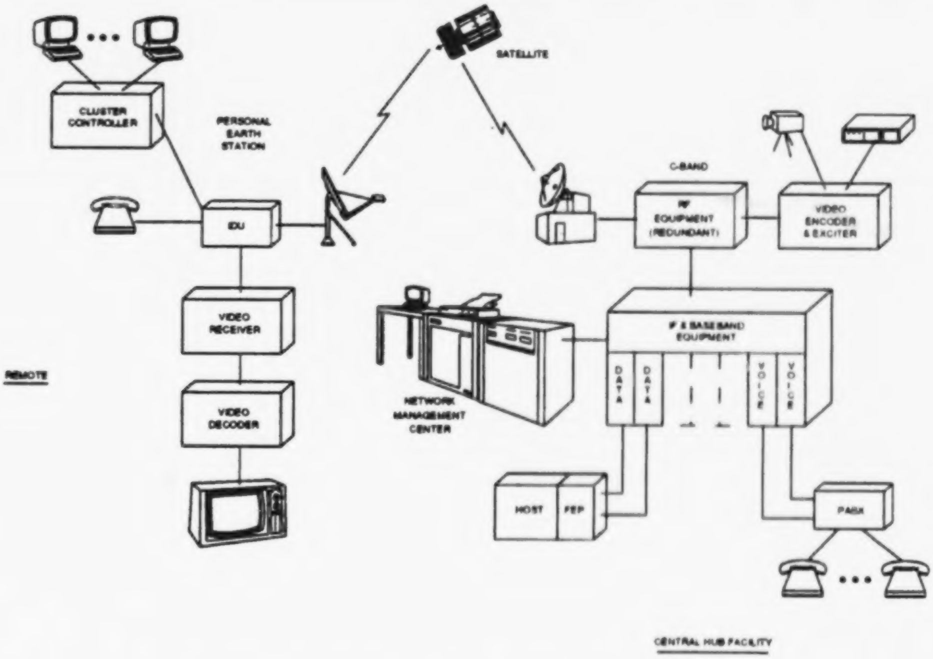
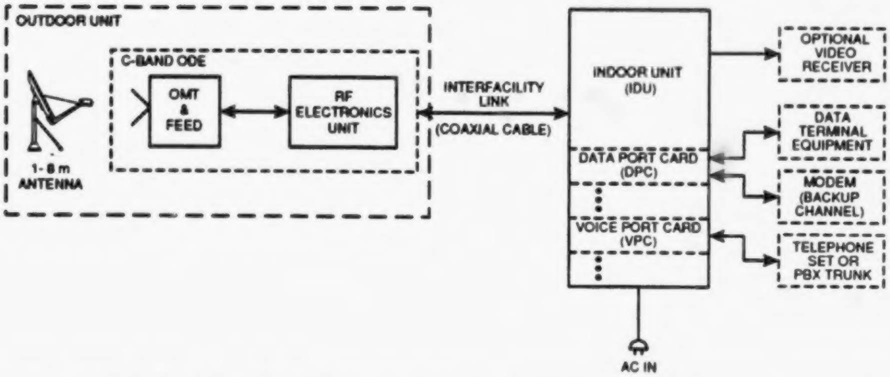

SATELLITE
CLUSTER CONTROLLER
PERSONAL EARTH STATION
IDU
VIDEO RECEIVER
VIDEO DECODER
REMOTE
C-BAND
RF EQUIPMENT (REDUNDANT)
VIDEO ENCODER & EXCITER
IF & BASEBAND EQUIPMENT
DATA
DATA
VOICE
VOICE
NETWORK MANAGEMENT CENTER
HOST
FEP
PABX
CENTRAL HUB FACILITY

Figure 4. Integrated Data, Voice, and Video VSAT Network


OUTDOOR UNIT
C-BAND ODE
OMT & FEED
RF ELECTRONICS UNIT
1-8 m ANTENNA
INTERFACILITY LINK
(COAXIAL CABLE)
INDOOR UNIT (IDU)
DATA PORT CARD (DPC)
VOICE PORT CARD (VPC)
OPTIONAL VIDEO RECEIVER
DATA TERMINAL EQUIPMENT
MODEM (BACKUP CHANNEL)
TELEPHONE SET OR PBX TRUNK
AC IN

NOTE: DATA PORT CARD REFERS TO EITHER THE REMOTE DATA PORT CARD (RDPC) OR THE MULTI-PORT CARD (MPC)

Figure 5. VSAT Block Diagram

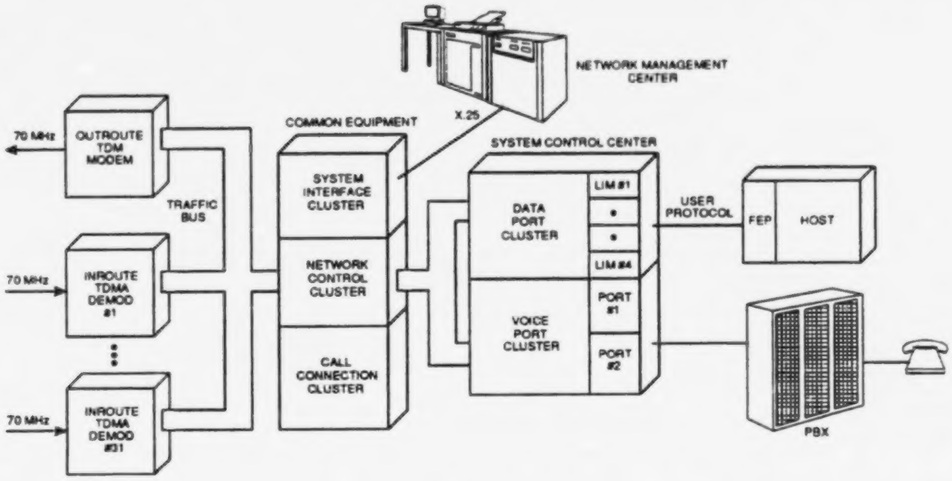

NETWORK MANAGEMENT CENTER
X.25
COMMON EQUIPMENT
SYSTEM CONTROL CENTER
70 MHz
OUTROUTE TDM MODEM
TRAFFIC BUS
SYSTEM INTERFACE CLUSTER
NETWORK CONTROL CLUSTER
CALL CONNECTION CLUSTER
70 MHz
INROUTE TDMA DEMOD #1
70 MHz
INROUTE TDMA DEMOD #31
DATA PORT CLUSTER
LIM #1
•
•
LIM #4
VOICE PORT CLUSTER
PORT #1
PORT #2
USER PROTOCOL
FEP
HOST
PBX

Figure 6. Hub Station Block Diagram (IF and Baseband)

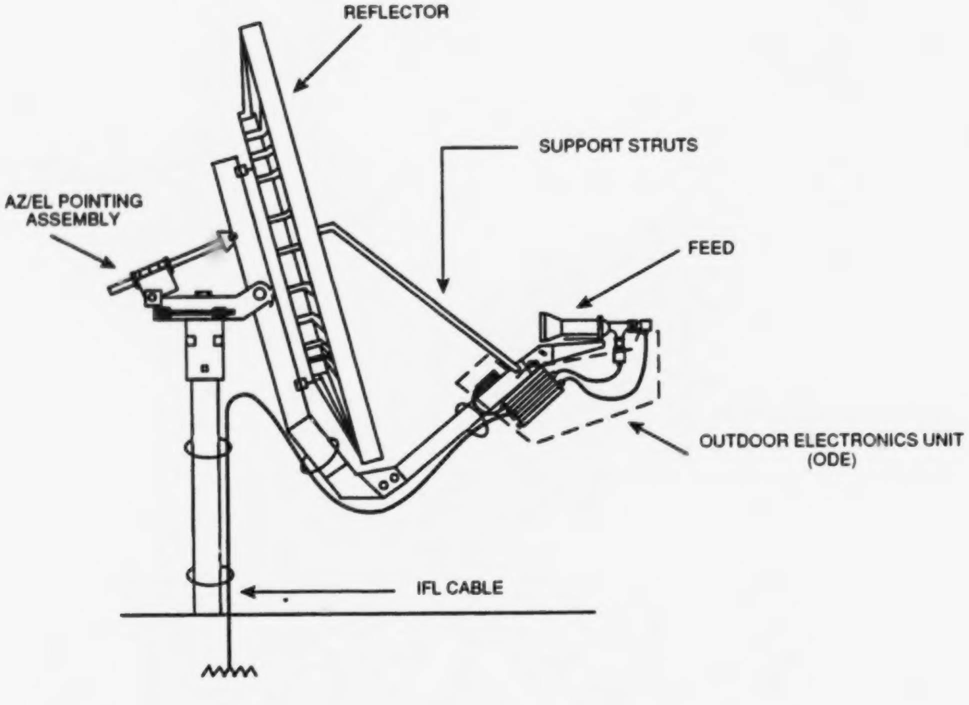

REFLECTOR
SUPPORT STRUTS
AZ/EL POINTING ASSEMBLY
FEED
OUTDOOR ELECTRONICS UNIT (ODE)
IFL CABLE

Figure 7. C-band PES VSAT

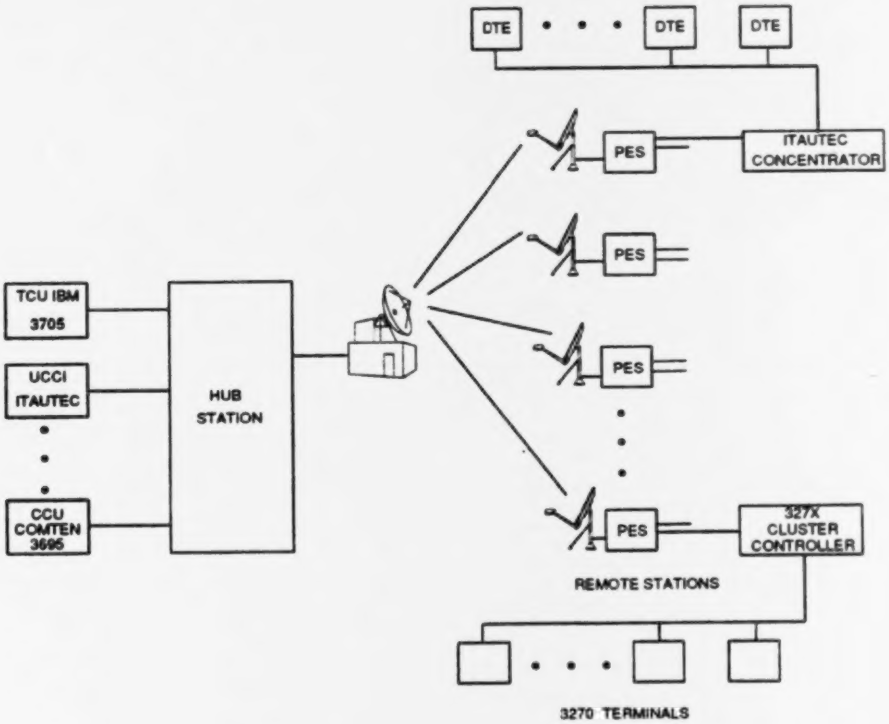

DTE
DTE
DTE
PES
ITAUTEC CONCENTRATOR
PES
TCU IBM 3705
UCCI ITAUTEC
CCU COMTEN 3695
HUB STATION
PES
PES
327X CLUSTER CONTROLLER
REMOTE STATIONS
3270 TERMINALS

Figure 8. Itau Bank C-band VSAT Network Configuration

VSAT Based Videoconferencing Networks

E. R. Cacciamani and Stan Kay
Hughes Network Systems
Germantown, Md

1. INTRODUCTION

Economical, efficient and flexible videoconferencing services have been promised throughout the 1980's. At last these prophecies are being fulfilled through improvements in video compression and the emergence of very small aperture earth terminals (VSATs). During this time we have seen substantial improvement in video codec performance with reduction in transmission rates by a factor of 7 and costs reduced by a factor of greater than 5.

At the beginning of the decade a major breakthrough enabled acceptable videoconferencing quality at 1.544 mbps. Today comparable quality is being achieved at 224 kbps and reasonable quality is being met at 56 kbps. Another factor has been the videoconferencing room equipment costs. Early implementations were based on television studio criteria and the cost of the rooms was nominally $500k. Thus the cost per site of videoconferencing during the early 1980's was $650k for the room facility and video codec plus transmission costs of at least $1500 per hour (if available on a per hour basis). More typically, special transmission facilities were constructed (i.e. satellite earth stations) which cost another $300k to $1,000,000 per site. It is not surprising, therefore, that the promised ubiquitous growth in videoconferencing did not occur during the 1980's.

Hopefully that is about to change in the 1990's with the advent of new video codecs and low transmission costs. The remainder of this paper focuses on the emerging VSAT technology and its application to videoconferencing. As a contrast to the costs of the early 1980's of up to $1.5m per site, today's technology can be installed at less than $100k per site (including video codec, room facility and VSAT terminal) with far more flexibility and service capability than the earlier $1.5m systems. Further, VSAT technology enables multi-site simultaneous conferencing on a demand switching basis. This capability is easier to implement using VSATs since it is a satellite broadcast based technology vs. terrestrial which is inherently point-to-point.

2. RECENT TECHNOLOGY TRENDS

The 1980's have seen important technology evolutions that are leading to low cost and flexible digital compressed interactive videoconferencing.

VSATs have become an extremely important data networking technology and with tens of thousands of VSATs sold to date, a mass produced satellite technology is now available to serve broadcast and multi-site location communications services. Today, VSATs can provide data rates up to 512 kbps with costs per site at approximately $10,000 each. Included in the VSAT technology is a sophisticated management and control system which enables dynamic switching of resources in the network.

Video Compression Codecs have also evolved, during the 1980's both in lower comparable bit encoded transmission rates and lower costs. As stated earlier, video codec costs have been reduced from a high of $150,000 to today's low rate codecs at $20,000 - $25,000 and still dropping. The compressed transmission rates have dropped from 3 mbps to today's approximately 224 kbps and, for certain applications, as low as 56 kbps.

3. POINT-TO-POINT VIDEOCONFERENCING

Typical videoconferencing connections today are point-to-point using either satellite or land line transmissions to connect two or more site pairs. In some applications there is a switching capability so that one site can conference to different sites in the network but generally one at a time. The ability to conference multiple sites simultaneously has been limited and at best awkward and expensive to achieve.

Equipment has been developed relying on terrestrial communications facilities to provide a "star" matrix switch to enable multi-site conferencing. This approach requires that all sites transmit their video and audio to a single location where the signals are multiplexed, switched and retransmitted back to each site. The video transmitted back to each site is typically controlled by voice activation and managed through a centrally located multiplexer. Obviously this approach requires duplex circuits continuously active to and from each of the participating sites to the central site.

A better approach is to link all of the sites via satellite, which is inherently a broadcast medium, and can therefore easily provide rapid switching and immediate broadcast distribution directly on a mesh connected basis. To date cost effective systems have not been implemented to provide this type of service.

The remainder of this paper describes a new and unique system that takes advantage of all of the advances in the technologies previously described and that provides a cost effective multisite simultaneous video and audio conferencing capability.

4. MULTI-SITE VSAT VIDEOCONFERENCING SYSTEM

Hughes Network Systems (HNS) has recently developed a VSAT based N-way Videoconferencing system.

The advantages of using a VSAT system include (1) low costs; because it is based on a mass produced existing technology, (2) easy access; since blanket licensing exists for Ku VSAT systems and (3) rapid and low cost installation; since the terminals are small and multiple nationwide installation facilities exist because of the existing VSAT market base.

The HNS product is called the inTELEconference™ System.

4.1 InTELEconference SYSTEM ARCHITECTURE

As shown in Figure 1, the inTELEconference™ system provides mesh connected simultaneous video and audio conferencing among N-sites. The number and location of the sites defined is variable and dynamically switched per each conference. A Network Control Center (NCC) site provides the capability to manage the sites' N-way connectivity from a given pool of M total sites, where M is the general population of sites controlled by the NCC.

The key distinguishing feature of this approach versus the previously described land based star multiplexed system is that the maximum number of transmission links required to support N-way conferencing is 2.

A TDM link is used to transmit video (one for the N-way network) which can be switched (baton passing) from site to site on demand. The switchover time from one site to the next is less than two seconds. A second carrier operating in TDMA mode is used to link all of the N-sites with simultaneously bridged audio. Variations on this configuration can be implemented by adding additional video carriers to provide more than one simultaneous video transmission per conference.

4.2 TECHNICAL DESCRIPTION

The InTELEconference™ terminal is VSAT based and is shown in Figure 2.

The terminal consists of a TDM/TDMA modulator which enables it to transmit video plus audio using TDM or only audio via TDMA. This mode of operation is dynamically switched at each site depending on that site's requirements to transmit video. Each terminal consists of a TDM demodulator and a TDMA demodulator which enables it to simultaneously receive the audio from all sites in the conference plus video from the video broadcasting site. The data rates described in this configuration consist of 256 kbps compressed digital video (TDM) and 16 kbps RELP compressed digital voice (TDMA). Typical antenna size of the inTELEconference™ terminal is 2.4 meters.

4.3 NETWORK OPERATION AND CONTROL

The control of the network is based at the Network Control Center (NCC) which uses the same VSAT terminal used at the other sites and an AT class PC to maintain and distribute the scheduling database. At each remote site an XT class PC provides storage for the local station's schedule and provides the intelligence needed to control conferences. The NCC uses a common TDMA channel for communication with stations which are not active in a conference.

THE NCC PC SUPPORTS:

- Scheduling and rescheduling of video conferences from screens at the PC.
- Scheduling and rescheduling of video conferences via an electronic link to an external scheduling system.

- Downloading of the scheduling database to the remote stations.

- Network monitoring by polling idle remote stations to determine their status and providing status screens for display at the NCC.

The remote station PC will support configuration of the station during conference setup and provide online support during a conference. The communication paths available between stations for control purposes depend on the type of conference. An embedded 1200 bps asynchronous channel is transmitted with the video stream and is used to send control messages to other stations from the station transmitting video. For stations transmitting TDMA, a portion of each burst is reserved for control messages. No communication path is provided between the NCC and a remote station while that station is active in a conference.

The control channels that are active during the conference allow communication between stations for control purposes while a conference is in progress. These control channels support baton passing operations during N-Way conferences, removal of a participant from a conference at his request, and orderly conference termination as a function of time or user request.

In addition to the three basic types of conferences, the inTELEconference^{TM} system is capable of supporting additional types of conferences by incrementally upgrading the basic system software.

- A lecture type conference can be handled as a broadcast conference with a limited audio communication capability from the receiving stations using demand-assigned slots in the TDMA channel.

- A Controlled Audit capability can be added that would allow a conference to be audited or monitored at an authorized location.

- A 2+N-Way conference will permit adding a second video channel to the N-Way conference to allow the baton holder to observe any of the other sites. The baton holder can individually select each station to transmit on the second video channel. The secondary visible station can be changed at any time by the baton holder.

- Audio-Only conferences could be supported by using a single TDMA channel to support up to eight participants.

Figure 3 illustrates four of the possible inTELEconferencing^{TM} modes of operation.

5. SUMMARY AND CONCLUSIONS

The VSAT based videoconferencing system described provides a low cost and uniquely flexible multi-site video conferencing capability. Some of the key features provided include:

- Multi-site simultaneous teleconferencing

- Flexibility - for activating new sites and quickly reconfiguring the conference network

- Efficient space segment utilization (minimum number of carriers to support a conference)

- Centralized computer automated network control and reservation center

- Takes advantage of low bit rate compressed video to provide cost-effective transmission

- Broadcast conferencing capable

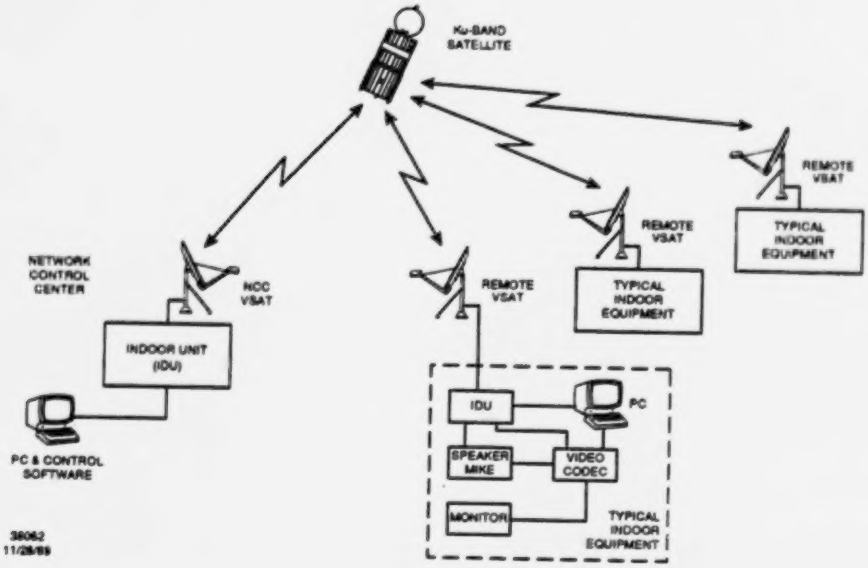

Ku-BAND SATELLITE
NETWORK CONTROL CENTER
NCC VSAT
INDOOR UNIT (IDU)
PC & CONTROL SOFTWARE
REMOTE VSAT
IDU
PC
SPEAKER MIKE
VIDEO CODEC
MONITOR
TYPICAL INDOOR EQUIPMENT
REMOTE VSAT
TYPICAL INDOOR EQUIPMENT
REMOTE VSAT
TYPICAL INDOOR EQUIPMENT
36062
11/28/89

Figure 1. InTELEconferencing System

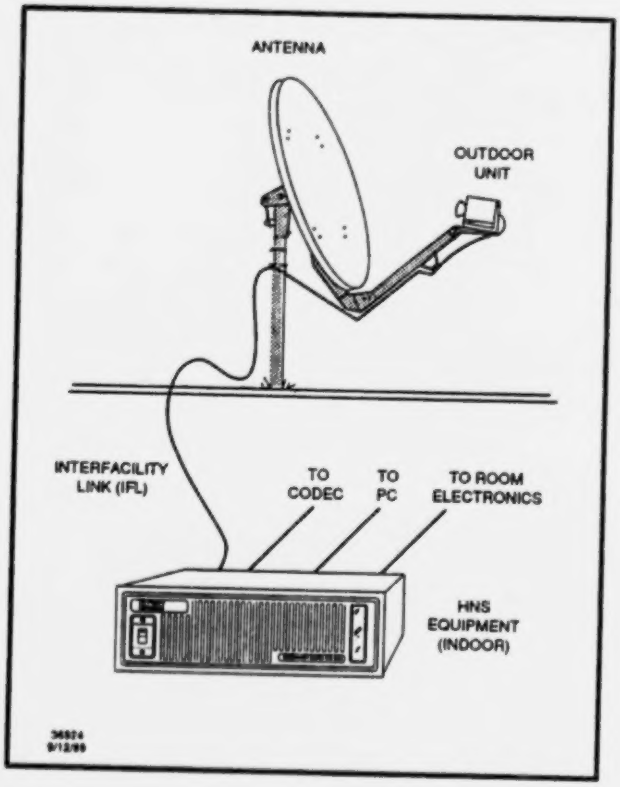
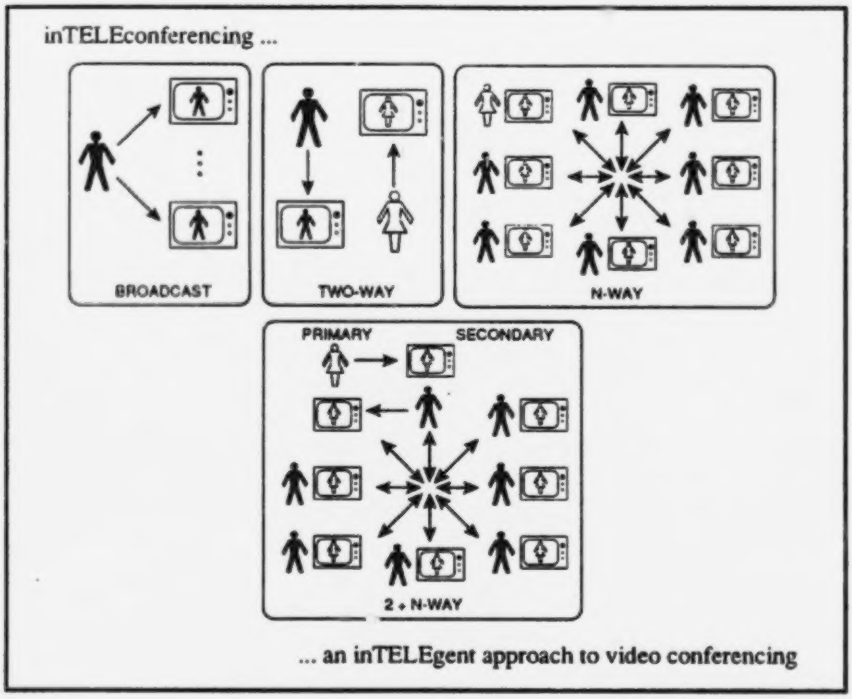

ANTENNA
OUTDOOR UNIT
INTERFACILITY LINK (IFL)
TO CODEC
TO PC
TO ROOM ELECTRONICS
HNS EQUIPMENT (INDOOR)
36524
9/12/89

Figure 2 - VSAT Video Satellite Terminal


inTELEconferencing ...

BROADCAST
TWO-WAY
N-WAY
PRIMARY
SECONDARY
2 + N-WAY

... an inTELEgent approach to video conferencing

Figure 3 InTELEconferencing Modes

A Shared-Hub VSAT Network for the ASEAN Region

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JL Jendral Sudiran KaV21
Jakarta, Indonesia

and

Macy Summers
Scientific-Atlanta, Inc.
4356 Communications Drive
Norcross, GA 30093
U.S.A.

P. T. Citra Sari Makmur [CSM] and Scientific-Atlanta, Inc., in cooperation with the telecommunications Authority of Indonesia [Perumtel], will design, install and operate a shared-Hub VSAT network utilizing the Palapa satellites covering the ASEAN region. This paper discusses the impact of this strategic technology on regional development and information management.

OUTLINE

I. Introduction

This section will cover the 13-year history of the Indonesian Palapa satellite system and its gradual development into a regional satellite network. The various services offered over the years will be discussed culminating in an overview of VSAT networks in general and their impact on data communications and information management in developed nations.

II. VSAT Technology and Information Management

The specific areas where VSAT technology has a direct impact on information technology will be highlighted as follows:

A. VSAT Network Architecture

B. Implementation of PPNs Using SNA/SDLC and Other Protocols

C. Network Control and End-User Interface

D. Satellite Access Technique

III. The CSM/Perumtel VSAT Network

A general overview of the VSAT network to be installed and operated by CSM/Perumtel will be described here highlighting the shared HUB concept and its utilization for the region.

IV. VSAT Technology and ASEAN Regional Development

This section will present various applications of VSAT technology appropriate for the ASEAN region and the projected impact on regional development through enhanced information management.

V. Conclusion

A brief summary of the topics covered and concluding remarks relevant to regional information management and VSAT technology as an appropriate vehicle for further development.

Introduction

On August 17, 1976 Indonesia's domestic satellite communications system was inaugurated by President Soeharto and formally placed into service. Culminating years of planning by the state telecommunications authority, *PERUMTEL*, and major allocation of scarce development funds, the Republic of Indonesia took the bold initiative to become the first Asian nation and the third nation after the United States and Canada to operate its own domestic satellite communications system. The original Palapa system consisted of two geostationary satellites and forty ground stations providing telephone, telex and domestic television service to Indonesia's provincial capitals and major cities. The basic telephone network comprised several hundred channels of FM multiplex for trunk service between major cities and 200 channels of *Single Channel Per Carrier* [SCPC] *Permanently Assigned* [PA] for point-to-point trunk service to smaller cities. The advent of high-quality telecommunications to Indonesia's most remote islands and the capability for full coverage of Indonesia's 13,000 island archipelago set in place a framework for continued growth and improvement of telecommunications services throughout the nation.

In the subsequent ten years after inauguration, the Palapa system added another 100 earth stations, over 1,000 channels of SCPC and 1,200 channels of FM multiplex to meet the traffic demands of the new earth stations and expanded capacity at the original forty earth stations. To improve efficiency of the SCPC network a *Demand*

Assignment Multiple Access [DAMA] system was implemented providing point-to-multipoint connection capability for most of the SCPC channels. In 1985 a ten-node *Time Division Multiple Access* [TDMA] system was implemented at major cities to relieve some of the demand on the other telephone trunk systems. These developments, in conjunction with the installation of new automatic telephone exchanges throughout Indonesia, have enabled *PERUMTEL* to provide domestic long-distance direct-dial telephone service for the nation.

The past three years have witnessed additional growth in excess of the previous ten years of Palapa system operation. This year alone will include the installation of another 100 additional earth stations, further expansion of the FM multiplex system, expansion of the DAMA system handling capacity from 2,500 circuits to 14,400 circuits and addition of another 11 nodes to the TDMA system. While this expansion is dramatic in itself, there are further plans to add another 2,000 SCPC channels and implement transponder hopping for both the DAMA and TDMA systems.

Palapa system growth has not been limited to the *PERUMTEL* telephone network only. In addition to the original state television channel, transponders are now utilized for two channels of Thailand television, two channels of Malaysian television, and the ASEAN television channel. SCPC PA service has been extended to include a Thailand network, military users, ASEAN cross-border communications, leased-channel service for the petroleum industry and distributed service for remote education. This rapid growth in the utilization of the Palapa system for telephone service in the private sector has had a major influence on rural development, by opening telecommunications access to these regions. It has also enhanced provincial development by improving communications services to regional capitals. While the growth of this system has certainly been impressive, it should be noted that this growth has been primarily to support growing demand for telephone trunks. The Indonesian government has been under pressure by the business community to improve and broaden telecommunications services to keep pace with economic development in the private sector. To meet this challenge, during the next five-year development plan, Indonesia will invest nearly (US$) 2.9 billion for an additional 1.5 million new telephone lines. Indonesia has invested heavily in ocean cable projects, and (US$) 4.5 billion, for a new *Integrated Services Digital Network* [ISDN], to expand data communications. To date, very little attention has been given to utilization of the satellite system for widespread data communications, but in light of the planned development, it is clear that the stage has now been set for the introduction of a full-capacity VSAT network.

Early in 1989, Indonesia took a great step in meeting these demands for data communications. Officials of *PERUMTEL*, the ministry of telecommunications, reached an agreement with Scientific-Atlanta and a private Indonesian firm, Citra Sari Makmur [CSM] to install, operate, and market a VSAT satellite network that will link as many as 4,000 sites.

What is a VSAT?

A *Very Small Aperture Terminal* [VSAT] is precisely what its name implies: a satellite earth station with a very small aperture, or antenna. Modern state-of-the-art VSATs employ a small antenna diameter [~.7 - 1.8-meter] and electronics which can be easily transported by one or two persons, and installed in just a few hours. A typical VSAT network consists of at least one central large-capacity earth station referred to as the hub and hundreds or thousands of VSATs. The VSATs communicate with the hub in a star network configuration providing two-way data, voice, and one-way distributed video service. Aside from physical size, the characteristic feature of VSATs is the satellite access methodology, or the manner in which the satellite transponder bandwidth is utilized. For interactive data communications, there are several satellite access methods in use. The most common are: Aloha, Slotted-Aloha, TDMA, and spread spectrum. The first experiments of packet satellite access technology for VSAT application were conducted over NASA's ATS satellite in the late 1970s. A specific protocol, Aloha, was developed at the University of Hawaii for this application in 1973. It was not until the 1980s that intense interest in data communications and information technology led to the full commercialization of VSAT technology. Today, in developed nations, the VSAT network has been demonstrated as a cost-effective alternative for providing one-way distributed data, interactive data, and point-to-multipoint communications. With the first commercial VSATs installed in the mid-1980s, the number of operating VSATs in the United States alone has grown to tens of thousands, and the list of VSAT users includes a wide diversity of businesses: from banks, airlines and hotels, to drug stores, retailers, logging companies, the military and government.

The evolution of VSAT technology has been a direct outcome of the information revolution that has swept the developed nations in the past decade. It is the marriage of convenience between satellite-based telecommunications and terrestrial digital networks. As the need for improved information transfer and management impinges on more sectors of society, the requirement for improved data communications is ever increasing. VSAT technology plays an important role in this development by providing complete, wide-area coverage for networks which cannot be achieved economically with terrestrial systems. And with the introduction of Ku-band [12 to 14 GHz] satellites, and improvements in *Microwave Integrated Circuit* [MIC] manufacturing techniques, the physical size and cost of VSAT hardware is continually dropping. Thus, while VSAT technology has certainly come of age in developed countries, there is no end in sight to further improvements or new applications for this strategic technology.

This paper will examine in detail just how the Scientific-Atlanta VSAT network functions by looking at the VSAT network architecture, network control, end-user interface and satellite access techniques, and then discuss the implementation of VSAT technology in the ASEAN region. Finally, we will examine the potential impact of this technology as it takes root in ASEAN, the benefits, and the resultant influence on regional development.

VSAT Technology and Information Management

The basic topology of the VSAT network [at the physical layer of an information network] is inherently a star network wherein a single hub station collects inbound packetized data from a large number of VSATs and broadcasts outbound messages which are time-multiplexed and individually addressed to the VSATs. However, this concept applies only with reference to the VSAT network as the media for the information network. In most applications, where very fast network access and response time is not critical, a virtual full-mesh [VSAT-to-VSAT] system is practical. In a shared-hub environment, both topologies, star and full-mesh, may exist simultaneously in the form of *Closed User Groups* [CUG] and CUGs may be interconnected to form subnetworks. Thus, the VSAT network can be configured to accommodate most information network architectures.

VSAT NETWORK COMPONENTS

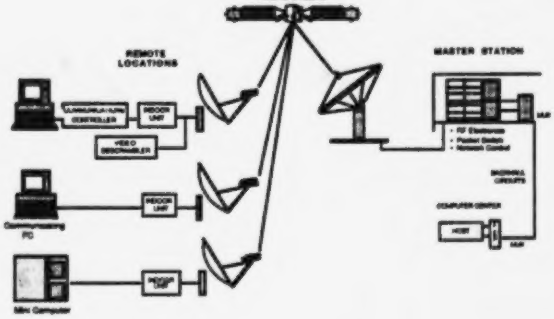
REMOTE LOCATIONS
MASTER STATION
CONTROLLER
INDOOR UNIT
VIDEO DESCRAMBLER
• RF Electronics
• Packet Switch
• Network Control
COMPUTER CENTER
HOST
Mini Computer

FIGURE 1 - VSAT NETWORK CONFIGURATION

In order to interface with different protocols which may be used by individual VSAT network users, CUGs or subnetworks; various standard or specialized Packet Assembler/Disassemblers [PAD] may be employed within the VSAT and hub locations. Since a common protocol is used within the VSAT network itself, it is feasible to establish communications between any two VSATs or between any VSAT and any hub PAD, regardless of the particular end-user's protocol. The combination of total wide-area [ASEAN] coverage, multiple network architecture [star and full-mesh] and the ability to interface and interconnect virtually all end-user protocols, underscores the VSAT network as a highly adaptive and efficient alternative for any information network.

VSAT Network Architecture

As previously mentioned, the basic SkylinX.25 VSAT network architecture is a simple star network based upon a central packet switch located at the hub station. It may also be described as an intelligent architecture, since the network traffic at the physical layer is automatically optimized for most efficient utilization of the satellite transponder, and PAD software can be downloaded from the hub allowing changes to the protocol conversion at each node without network reconfiguration. The internal packet switch architecture is based upon CCITT X.25 which allows for direct connection of the network packet switch to other X.25 user packet-switched networks. Using open X.25 architecture, it is a simple matter to add and remove terminal-to-host and host-to-hub connections, move host locations, and quickly establish permanent or switchable virtual circuits.

SKYLINX.25 NETWORK

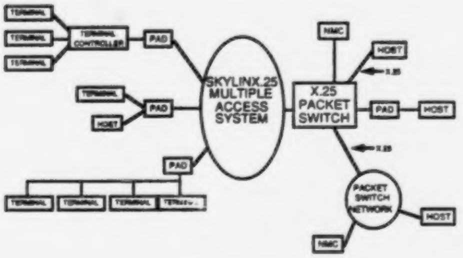
TERMINAL
TERMINAL
TERMINAL
TERMINAL CONTROLLER
PAD
TERMINAL
HOST
PAD
PAD
TERMINAL
TERMINAL
TERMINAL
TERMINAL
SKYLINX.25 MULTIPLE ACCESS SYSTEM
X.25 PACKET SWITCH
NMC
HOST
X.25
PAD
HOST
X.25
PACKET SWITCH NETWORK
HOST
NMC

FIGURE 2 - VSAT NETWORK ARCHITECTURE

Implementation of PPNs Using SNA/SDLC and Other Protocols

Because of IBM's dominance in the computer marketplace during the 1970s, Systems Network Architecture [SNA], originally developed for IBM type 370 mainframes, has become perhaps the most common host-based architecture in use today. Through the use of standard host and terminal PADs, the VSAT network can easily implement the SNA/SDLC environment.

SKYLINX.25 SNA/SDLC ENVIRONMENT

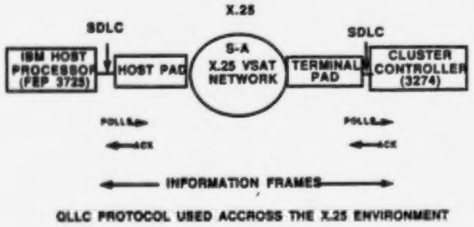
X.25
SDLC
SDLC
IBM HOST PROCESSOR (FEP 3725)
HOST PAD
S-A X.25 VSAT NETWORK
TERMINAL PAD
CLUSTER CONTROLLER (3274)
POLLS
ACK
POLLS
ACK
INFORMATION FRAMES
QLLC PROTOCOL USED ACCROSS THE X.25 ENVIRONMENT

FIGURE 3 - VSAT NETWORK IMPLEMENTATION OF SNA/SDLC

The key to implementation of SNA is to interface to the basic SNA protocol, *Synchronous Data Link Control* [SDLC] which is employed between the host computer Front End Processor [FEP] and the cluster controller. The VSAT network can accomplish this in several ways. The first, and most conventional technique is to physically locate the host FEP at the VSAT hub station, then connect the FEP to the VSAT network with a standard host PAD contained within the HUB. At the the terminal [VSAT] location, a standard SNA/SDLC PAD, also within the VSAT, is used to connect the cluster controller to the VSAT network. A second similar technique is to interconnect the host FEP to the hub station via a terrestrial communications facility, then use an appropriate PAD to enter the VSAT network. Yet a third technique is to locate the host computer(s) at the VSAT location(s) with a suitable host PAD at the host VSAT location. In each case, the terminal location configuration remains the same. This flexibility allows for the user host computer to be located at any point within the VSAT network coverage with little or no network reconfiguration required of the end-user.

Aside from SNA/SDLC, the VSAT network also supports standard protocols, such as IBM BSC, X.25, ASYNC [ASCII], UNISYS UDLC, and custom protocols. Since the remote VSAT PAD uses firmware downloaded from the hub to interface to the remote protocol, implementation of other protocols is accomplished by operator command from the hub station. In addition, protocol conversion supports local polling emulation in which the PAD software at the hub emulates the remote site cluster controller hardware by responding to polling commands, while the remote VSAT PAD emulates the host FEP by generating polling messages. As a result, end-user polling messages are not sent through the VSAT network, so that link propagation delay does not degrade the end-user's protocol efficiency.

Network Control and End-User Interface

There are two separate aspects which must be considered with respect to network control; first, control of the VSAT network itself, and second, control of the end-user network which is implemented within the VSAT network. These two aspects of network control are discussed individually below.

The network monitor, maintenance, and control system is an integral part of the SkylinX.25 VSAT network hub station design. As part of the hub station packet switch, there are several software modules which constitute the *Network Control System* [NCS]. By way of dedicated packet switch ports and the NCS bus handler, the operator terminal permits the hub network operators to perform the following functions:

(1) Monitor end-user traffic throughout the satellite network.

(2) Configure all nodes, physical connections, and communications links within the network.

(3) Download software to remote VSAT controllers and PADs.

(4) Monitor and control communications hardware at the hub station and all remote VSATs.

These software modules share a common global data base, which is continually updated by periodic network polling, operator commands, and alarm routines. This data base constitutes the entire network configuration and status elements, and is shared by another important software module, the *Data Traffic Monitor and Control* [DTMC] module. The DTMC supports network traffic analysis functions which permit the network operator to monitor network throughput, delay and utilization by both VSAT and data link. Together, the DTMC and other NCS modules permit the network operator to create and edit all the data necessary to configure, activate and deactivate data links and remote VSATs. The operator can control communications hardware at both the hub station and remote VSATs. In addition, he can collect and display information on traffic flow, link integrity, and hardware status to provide a real-time display of all critical parameters of network performance.

When an end-user Private Packet Network [PPN] is properly implemented within the VSAT network, the VSAT network becomes transparent, so that no additional end-user network monitor and control functions are normally required. However, when there is an end-user network link or terminal failure, the end-user operator must be able to isolate this to either the VSAT network or his own network. There are several ways to accomplish this, the most obvious being to maintain a communications link between the VSAT network and end-user operators. When an end-user network problem occurs, it is a simple matter to confirm if there is a coinciding VSAT network problem. At each VSAT location, there are both hardware and link integrity alarms, so that the remote end-user can monitor the VSAT network status. It is also possible to establish a terrestrial link via modem between the hub station and the remote VSAT for diagnostic purposes. In general, VSAT/end-user network failure ambiguity is very unlikely, and readily interpreted through VSAT network NCS displays or remote VSAT diagnostics.

Satellite Access Technique

The primary objective in choosing the satellite access technique is to maximize network throughput while minimizing network response time. The satellite access method employed by Scientific-Atlanta's VSAT network is *Adaptive Reservation Slotted Aloha* [ARSA], a unique hybridization of TDMA and slotted Aloha. Individually, these access techniques make effective use of the satellite transponder bandwidth for either high or low traffic loading, but cannot accommodate wide fluctuations in network activity. By combining them in ARSA, efficient transponder usage can be achieved during all levels of network activity. This can best be understood by looking carefully at the method employed by each technique, TDMA and slotted Aloha, in utilizing the satellite transponder.

A TDMA-based access technique is characterized by very high throughput efficiency and very efficient transponder usage. In a pure TDMA network, instead of transmitting individual carriers on different frequencies [as in SCPC systems], earth stations transmit blocks of information at different times. The earth stations are synchronized so that each block is transmitted at a specific time and blocks do not overlap as they are transmitted over the satellite transponder. In the simplest format, one block of data from each earth station are combined to form a frame. The frames are assembled/disassembled at each end of the TDMA link to recover the original data.

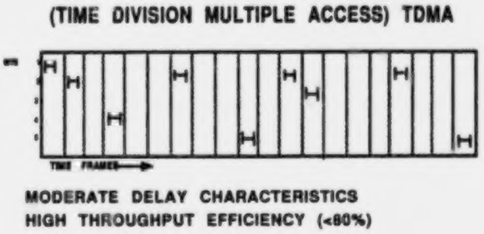
(TIME DIVISION MULTIPLE ACCESS) TDMA
TIME FRAMES
MODERATE DELAY CHARACTERISTICS
HIGH THROUGHPUT EFFICIENCY (<80%)

FIGURE 4 - TDMA TRANSMISSION FORMAT

Since each block of data occupies a unique time slot in the TDMA frame, theoretically no block interference occurs, and very high throughput efficiency can be attained. This method of transmission is ideal for high-volume data transmission, such as batch transfer applications. However, with TDMA, high throughput is achieved at the sacrifice of network response time, so that for interactive networks or networks with low-volume data or irregular data from a large number of nodes, TDMA becomes less desirable.

Slotted Aloha is a random-access, contention mode of transmission in which the earth stations in the network transmit at any time there is data to be sent. They effectively "access" the satellite transponder at "random", and "contend" for the transponder link to the hub station. As network activity increases, collisions [two or more VSATs attempting to transmit to the hub station simultaneously] occur. When a collision does occur, the normal data receipt acknowledgement message from the hub station is not received at the VSAT location, and the VSATs automatically retransmit after a pseudo-random time delay.

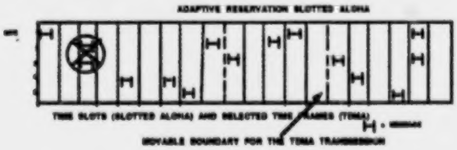
ADAPTIVE RESERVATION SLOTTED ALOHA
TIME SLOTS (SLOTTED ALOHA) AND SELECTED TIME FRAMES (TDMA)
MOVABLE BOUNDARY FOR THE TDMA TRANSMISSION

FIGURE 5 - SLOTTED ALOHA TRANSMISSION FORMAT

Obviously, with slotted Aloha, network response time can be extremely fast, limited only by the inherent satellite link propagation delay and hub station packet switch response time. However, as network activity increases, collisions increase and throughput efficiency decreases rapidly. Slotted Aloha is ideal for applications in which there is intermittent transmission of low-volume data, such as in typical interactive networks, and where fast network response time is required.

In practical day-to-day application, most networks have periods of low activity and high activity, and periods of low-volume and high-volume data transmission. This is typical of bank networks, for example, where daily office hours involve frequent low-volume interactive transmissions while night hours are used for high-volume batch transfers. So that for most networks, neither TDMA nor slotted Aloha alone is efficient during varying levels of network activity. To accommodate this typical network situation, Scientific-Atlanta developed ARSA . As mentioned, ARSA is a hybridization of TDMA and slotted Aloha, employing each format in an adaptive mode as the network activity and throughput demand. Basically, during low-throughput periods, slotted Aloha is used. As network throughput approaches approximately 36 percent, slots in the frame which were previously contention are reassigned as reserved slots [effectively TDMA mode]. The boundary between contention and reserved slots can vary to meet throughput requirements.

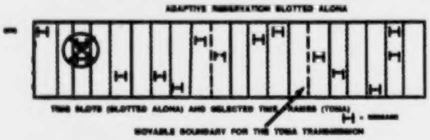
ADAPTIVE RESERVATION SLOTTED ALOHA
TIME SLOTS (SLOTTED ALOHA) AND SELECTED TIME FRAMES (TDMA)
MOVABLE BOUNDARY FOR THE TDMA TRANSMISSION

FIGURE 6 - ADAPTIVE RESERVATION SLOTTED ALOHA [ARSA] FORMAT

Thus, the ARSA access technique is based upon dynamic adaptation to the level of network traffic, actively switching between contention [random-access] and TDMA modes. By doing so, ARSA is able to take advantage of each mode's efficiency at different traffic levels, thereby maximizing overall network utilization during all levels of traffic activity. For a designed saturation level of 37 percent for a pure Aloha system, typical average channel [slot] utilization is only 8 to 9 percent. ARSA is able to achieve high average channel utilization at the cost of only a few additional milliseconds in network response time.

ADAPTIVE RESERVATION REDUCES BARNETT'S RISK OF NETWORK FAILURE WHILE PROVIDING IMPROVED TELLER LINE PERFORMANCE

- Adaptive Reservation continuously optimizes access methods to:
  - Support mixed batch and interactive through a single branch controller port
  - Handle unexpected peaks without operator intervention
- And improves response time and throughput for better teller line performance

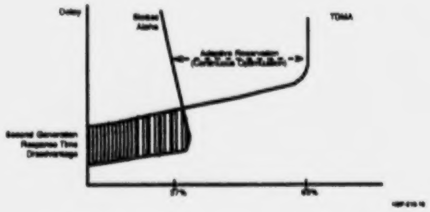

FIGURE 7 - ARSA THROUGHPUT/DELAY COMPARISON

Taking into account the data overhead requirement for network synchronization, addressing and control, an overall utilization level of 37 percent per return data link will provide the peak efficiency in allocation of the shared network data link facilities. It is clear that for typical network operation where there is a wide variation in network activity and volume of data transfer, ARSA is an innovative method of actively adapting the satellite access technique to achieve optimum network performance.

The CSM/Perumtel VSAT Network

P. T. Citra Sari Makmur [CSM] in cooperation with Scientific-Atlanta, Inc. and the *Telecommunications Authority of Indonesia*, Perumtel, has developed a shared-hub VSAT network to provide digital voice, data, and direct broadcast video service for customers in the ASEAN region. Network coverage will be confined to the Palapa satellite footprint which includes all of the ASEAN countries, parts of Australia, PRC, and the Southeast Asian peninsula.

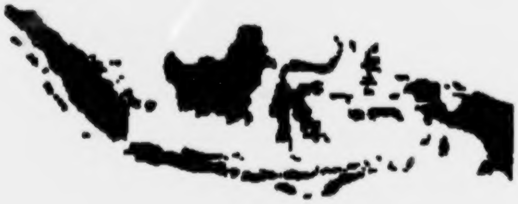

FIGURE 8 - PALAPA SATELLITE FOOTPRINT

The network is initially configured for a single shared-hub station located at Jakarta, Indonesia, and up to 4,000 VSATs which can be located anywhere within the Palapa satellite footprint area. The hub station is a permanent installation with full redundancy of all critical subsystems. It is designed for twenty-four hour operation and to provide network availability of 99.98 percent. The hub station will be operated and maintained jointly by CSM and Perumtel.

Network facilities will be leased based upon: VSAT, data ports, voice and video channels utilized by the customer. Customers may choose to locate their host computer at Jakarta or at any VSAT location, and each customer can be configured as a closed user group providing him a virtual private network. CSM will provide full support from customer network design through field installation of VSAT hardware and maintenance.

VSATs will be supplied by CSM and installed by CSM at customer premises. The VSAT may be installed on the ground, a pole, or on a building roof. CSM will provide all cabling and interface up to the customer terminal equipment. The underlying concept is that the customer will lease a network link(s) and will not have to be concerned with purchase of specific hardware, maintenance or repair, in much the same manner as a public telephone subscriber.

VSAT Technology and ASEAN Regional Development

As the Pacific rim positions itself to become a center of world economic activity towards the year 2000, keen awareness of new technologies and future trends is essential if the individual ASEAN nations are to become active partners and competitors in the world marketplace. To even gain sight of this goal requires a vast pool of specialized skills, resources, materials, and of course, finance, and this imposes several obstacles for developing nations. The conventional system of "technology transfer" is at best only an introduction of relatively new technology which is implemented by way of a careful balance between imported hardware and expertise against local labor and manufacturing. This system falls far short of permitting the developing nations to achieve a position of technological self-reliance, and since the cost of such technology transfer is often directly linked to foreign debt, this system serves only to maintain the de facto monopoly of new technology by developed nations. If this trend is to be reversed, developing nations must have ready access to new technologies as they emerge, they must have an enlightened social and political climate to implement the new technology, and finally they must have global access to financial and material resources in order to develop and market the products of this new technology. The key to gaining a foothold on new technologies is access to information. The role of the information revolution in developed nations has been proven to be both a fundamental tool in the technology implementation process as well as a catalyst for the development of new technologies. In developed nations, the spread of information networks by advanced telecommunications systems and computerization entering all aspects of everyday life have permanently altered the living, learning, and working patterns of their society at large. In the wake of this information revolution, there has been set in place an infrastructure for the manipulation and diffusion of information. All fundamental aspects of the society: work, play, education, health, economy, finance, communications, transportation, the government, and military are now inexorably controlled by information management. The impact of the information revolution raises many controversial sociological questions: What is the quality-of-life for the members of a modern information society? What detrimental effect does the information revolution have on culture, traditional values, the family? How does widespread dissemination of information affect national and regional security? Despite the potential risks posed to society, the future trend is clear. The information revolution will continue to sweep the globe, leaving no nation, however small or undeveloped, untouched. Therefore, the choice for any developing nation is straightforward: to secure a place as an active member of the global economy of the future requires active participation in the information revolution today. Failure to do so will only serve to broaden the gulf between the developed and undeveloped nations of the next century.

Active participation in the information revolution requires an integrated telecommunications system for the gathering, dissemination, and interactive handling of information. For the ASEAN region [comprising archipelago nations] VSAT technology is certainly the most appropriate technology for full coverage, and with the satellite communications system already in place, a VSAT network is much more economically attractive than alternative terrestrial systems. We have seen how a VSAT network functions, and how it is readily applied as the media for any information network. From a more practical standpoint of application, we can now consider the type of services which can be offered using the VSAT network for the ASEAN region. Although this summary is not intended to cover all potential applications, it does provide a good overview of the versatile range of applications for the VSAT network.

VSAT Applications for the ASEAN Region

- *Oil Exploration/Drilling*

  Wildcat rig communications, downhole data transfer, seismic data transfer, emergency communications

- *Mining Operations*

- *Logging Operations*

- *Meteorological Remote Sensing/Weather Data Transfer*

  Typhoon/hurricane early warning, data collection platform [DCP] data transfer

- *News Gathering Networks*

  News network [API, UPI] distribution, on-the-spot communications

- *Hotel Management*

  Reservations, guest arrivals, inventory control

- *Banking*

  Branch automation, transaction processing, account inquiries, ATM service

- *Finance*

  Stock exchange data distribution, brokerage firm activities

- *Travel/Tourism*

  Bookings, reservations, reconfirmations, tour tracking

- *Transportation/Shipping*

  Automatic consignment tracking, vessel and routing optimization

- *Inventory Control*

  Inventory management at multiple locations, optimized stocking/reorder

- *Disaster Recovery*

  Immediate restoration of communications facilities

- *Public Health*

  Transfer of radiographic imaging, on-line organ bank data, on-line medical diagnostic service, distribution of drugs/supplies to public health centers, communicable disease data collection

- *Retail Point-of-Sale Network*

- *Air Traffic Control Network*

  Regional ATC network, ground-air communications support

- *Energy Management*

  Power grid monitor/load switching, pipeline SCADA data transfer

- *Resource Management*

- *Publishing*

  Regional on-line database for research/marketing
- *Electronic Mail*

- *Agriculture*

  On-line database for regional farm product prices, quality, availability

- *Civil Defense*

  Emergency broadcast network, police/civil data networks

- *Public Education*

  Distributed computer-based education, public school network

- *Government Services*

  Regional databases for census, security, inter-government data exchange

Conclusion

We have seen how the SkylinX.25 VSAT satellite network provides broadcast capability over a wide area that cannot be accomplished with conventional terrestrial communications systems. Due to its unique system architecture and the ability to interface with most common protocols in use today, the SkylinX.25 VSAT network has been shown to be a very versatile and effective media. The various forms of satellite access techniques have been evaluated, and it was shown how the highly-adaptive ARSA technique optimizes satellite transponder usage. These features highlight VSAT technology as an innovative and cost-effective media for implementation of an information network.

Information is a unique and powerful resource, more so perhaps than natural resources, land mass, or energy. Yet it has not gained full recognition as a resource nor as a commodity by the world community. We have shown how information management underlies third world development, and how advanced telecommunications systems such as a VSAT network provide the necessary media for full implementation of information technology. It is evident that the global information era is fully replacing the industrial era as a stepstone in the global developmental process. In order to keep pace with world development, the acquisition of information technologies and adopting development strategies based upon these technologies is essential. Failure to do so by any nation may have long-term ramifications and dire consequences from which full recovery may not be possible. It is hoped that the introduction of a VSAT network to the ASEAN region will provide the impetus and working framework for regional participation in the world information revolution.

Session 4.2

ISDN Planning and Implementation

NOTES

INDIAN HILL BELL LABORATORIES 5ESS® SWITCH ISDN CENTREX

Robert J. Bockus and Robin J. Thompson
Telecommunications Services Center
AT&T Bell Laboratories

ABSTRACT

AT&T Bell Laboratories in Naperville, Illinois has installed 10,000 lines of Integrated Services Digital Network (ISDN) Centrex service provided by Illinois Bell Telephone (IBT). The ISDN service provides enhanced telephony features, ISDN key system capabilities, integrated call coverage systems, and integrated voice and data on the same connection. The service is provided by an AT&T 5ESS® Switch with the 5E5 generic along with several adjunct systems providing enhanced services such as Calling Name Display (CND), Station Message Detail Recording (SMDR), and network management capabilities. This paper provides an overview of the pre- and post-ISDN environments, including some of the special applications and the ISDN implementation process.

1. INTRODUCTION

AT&T has contracted with Illinois Bell Telephone (IBT) for 5ESS® Switch 5E5 ISDN Centrex service for the Indian Hill AT&T Bell Laboratories campus located in Naperville, Illinois. This is a full scale ISDN implementation providing telecommunications services for several Bell Laboratories office buildings. With almost 10,000 ISDN lines installed to date and the potential for additional lines in the future, the Indian Hill service ranks as the largest ISDN Centrex installation thus far. See Figure 1 for an overview of the campus environment, the cutover dates and the quantity of lines at each building. This paper provides an overview of the pre- and post-ISDN environments, including some of the special applications and the ISDN implementation process.

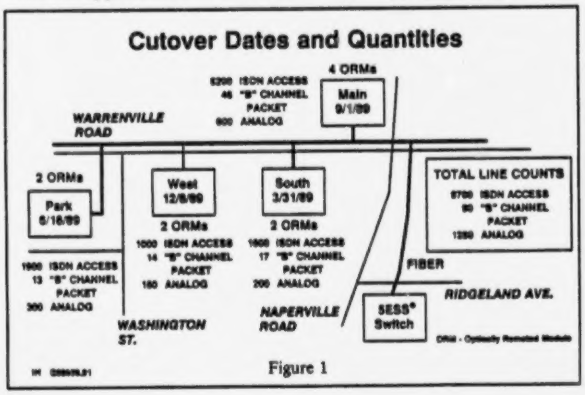
Cutover Dates and Quantities
4 ORMs
5200 ISDN ACCESS
46 "B" CHANNEL PACKET
600 ANALOG
Main 9/1/89
WARRENVILLE ROAD
2 ORMs
Park 6/16/89
1900 ISDN ACCESS
13 "B" CHANNEL PACKET
300 ANALOG
West 12/8/89
2 ORMs
1000 ISDN ACCESS
14 "B" CHANNEL PACKET
150 ANALOG
South 3/31/89
2 ORMs
1600 ISDN ACCESS
17 "B" CHANNEL PACKET
200 ANALOG
TOTAL LINE COUNTS
9700 ISDN ACCESS
90 "B" CHANNEL PACKET
1250 ANALOG
FIBER
RIDGELAND AVE.
WASHINGTON ST.
NAPERVILLE ROAD
5ESS® Switch
ORM - Optically Remoted Module

Figure 1

2. THE INDIAN HILL COMPLEX: PRE-ISDN

The Indian Hill complex consists of four buildings located several blocks apart with a population of approximately 7,000 employees. The primary work efforts are large scale telecommunications software design and development, including both the domestic and international versions of the 5ESS Switch.

2.1 VOICE

Prior to the ISDN Centrex implementation, telecommunications services were provided by two Dimension® 2000 Private Branch Exchanges (PBXs) and a System 85 PBX. Management and secretaries with call coverage responsibilities were provided custom key telephone or System 85 digital sets and the engineers and staff personnel were equipped with analog 2500 sets. System features provided on the PBXs included; call hold, call pickup, call forwarding, automatic callback, transfer, and three-way conferencing. The three PBXs did not provide feature networking between systems (e.g., automatic callback did not work between the PBXs).

Call coverage for management personnel was provided by departmental secretaries via electronic key terminals. Call coverage for engineers and staff was provided by answering machines located on the user's desk with some call pickup groups among co-workers.

2.2 DATA

Since software development is the main activity at the Indian Hill complex, there are a large number of mainframe, minicomputers, Personal Computers (PC) and asynchronous terminals. In fact there are about 1.4 data terminals or PCs per employee at the IH complex. Many employees have multiport terminals or two or more terminals on their desk to allow multiple entry points into the data network.

The major data network for terminal to host connectivity in use at IH is a Datakit® Virtual Circuit Switch (VCS) system. Various other AT&T-Bell Labs locations using Datakit VCS are networked together using dedicated facilities, thus providing a global AT&T Bell Laboratories computer network. As is the case in many other companies, the trend is towards workstations and intelligent desktop machines (AT&T PC Work Group Systems or 3B2 processors).

3. MOTIVATION FOR CHANGE

The IH complex is a campus environment which has been continually expanding since it was first established in 1966. The fourth building was completed in 1986 and plans were made to expand two of the existing buildings. At that time, the decision was made to provide telecommunications services from one integrated switching system to save administration cost, allow flexibility for growth, and provide feature networking and transparency across all the buildings. The obvious choice for a single flexible system in buildings located several blocks apart was Centrex service from Illinois Bell Telephone (IBT).

Given the desire to modernize the telecommunications services offered, as well as a desire to evolve voice and data applications together, the obvious choice for the technology was ISDN.

4. THE INDIAN HILL COMPLEX: POST-ISDN

Each of the buildings are served by two or more 5ESS Switch Optically Remoted Modules (ORMs) located on customer premises in space leased to IBT. The 5ESS Switch host office with the Administration and Communications Modules, along with additional Switching Modules is located in an IBT Central Office near the Indian Hill complex.

Since the Switching Modules are located in the Bell Laboratories buildings, Basic Rate Interface (BRI) service is provided by four wire T-interface cards eliminating the need for Network Termination 1's (NT1) on each line. In addition, three of the four buildings have centralized, battery backed up power systems to power the ISDN terminals. This avoids the need for individual power supplies for each phone as well as maintaining phone service in the event of a local power outage.

4.1 VOICE

Bell Labs has implemented, and gained cost and administrative efficiencies from most of the standard ISDN applications such as ubiquitous key systems with shared Directory Numbers, an integrated AUDIX voice mail system, calling name display, and electronic directory lookup with automatic calling. See Figure 2 for an overview of the ORM, AP and AUDIX configuration.

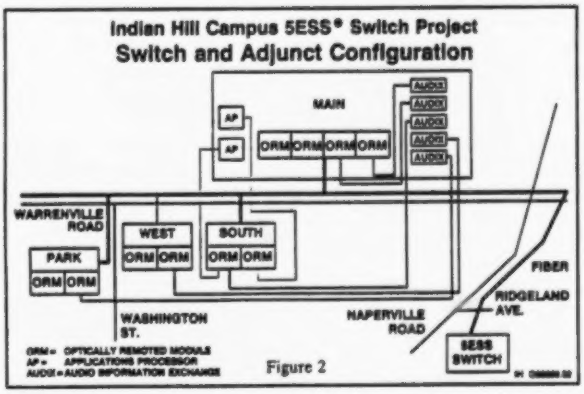
Indian Hill Campus 5ESS® Switch Project
Switch and Adjunct Configuration
MAIN
AP
AP
ORM
ORM
ORM
ORM
AUDIX
AUDIX
AUDIX
AUDIX
AUDIX
WARRENVILLE ROAD
WEST
ORM
ORM
SOUTH
ORM
ORM
PARK
ORM
ORM
FIBER
RIDGELAND AVE.
NAPERVILLE ROAD
WASHINGTON ST.
5ESS SWITCH
ORM = OPTICALLY REMOTED MODULE
AP = APPLICATIONS PROCESSOR
AUDIX = AUDIO INFORMATION EXCHANGE

Figure 2

Each user is provided with an ISDN line and an AT&T 7506 or 7507 multi-button ISDN display terminal. These terminals provide 17 and 40 programmable buttons respectively for assignment of call appearances or system features. Several features such as speakerphones, redial, and time and date display are provided by the terminal itself. System features provided by the 5ESS Switch and adjunct processors include those provided by the previous systems (Dimension and System 85) such as call hold, call pickup, call forward, transfer, conference, etc., as well as multiple call appearances, customer changeable speed calling, six way conference, and electronic directory with calling name display and autocall capabilities for calls within the Indian Hill complex.

The Applications Processor (AP) is an adjunct processor (3B2/600) with the Advanced Communications Package (ACP) software designed to provide enhanced features in conjunction with the 5ESS Switch. The Indian Hill installation was the first application of the new ACP version 5 with additional Station Message Detail Recording (SMDR) output formats and administrative enhancements.

The ACP feature which is most obvious to the end user is the Electronic Directory Service (EDS). This feature maintains the name/number relational data base which is used to provide the calling name display for calls which are originated and completed within the Centrex group. In addition, EDS provides the ability to do an electronic directory query from the ISDN terminal and automatically initiate the call.

Several AT&T Audio Information Exchange (AUDIX) voice mail systems have been provided to replace the answering machines on each user's desk. The AUDIX system has the capability to provide call coverage for calls while the user is busy or doesn't answer the phone. In addition, AUDIX provides the caller the option to transfer out of the voice mail system with a single button depression if it is necessary to talk to a human. The voice mail call coverage capability allows callers to leave detailed messages if they desire and it off-loads most of the call coverage duties for the secretaries, resulting in better productivity. The 5ESS Switch and the AUDIX systems perform in an integrated mode via a processor data link so that the call answering service and message waiting notification is provided for the appropriate end user. One of the advantages of the voice mail system compared to an answering machine is the ability to send voice mail broadcasts or announcements or to respond to voice mail directly without calling the end user. This is similar to an electronic mail application although some users find it easier to use because it is similar to making a simple telephone call.

4.2 DATA

The major ISDN data application at Indian Hill is to provide asynchronous terminal or PC to host connectivity with the added bonus of an installed network allowing PC to PC networking. In addition, we have taken advantage of the flexibility ISDN provides in terms of switching mechanisms and throughput rates to provide data networking up to 64kbps as required to meet additional end user's requirements.

4.2.1 ISDN to Datakit VCS Gateway

Due to the embedded base of Datakit VCS and associated capabilities, such as high speed host interfaces, networking software, and connectivity to other AT&T networks, it was desirable to provide an ISDN to Datakit VCS network gateway. The gateway was developed and implemented at the IH complex and is described in detail in the following section. As high speed ISDN host interfaces become available, the network will evolve from the ISDN-Datakit VCS configuration to end-to-end ISDN networking.

Each ISDN data user has a 7506 or a 7507 ISDN terminal with an Asynchronous Data Module (ADM) on their desk and their data terminal or PC communications port is connected to the EIA 232D port on the ADM. The ADM provides the EIA 232D to D channel X.25 Packet Assembly/Disassembly (PAD) function. Network connectivity is provided via the Basic Rate Interface (BRI) D channel packet switched capability of the 5ESS Switch.

The connection from the 5ESS Switch to the Datakit VCS network is a BRI carrying multiple X.25 logical calls on a single B channel allowing several users to access the Datakit VCS network via one BRI. The AT&T 7500 data module with a high speed synchronous board provides the lower layer conversion from 2B + D to V.35, but does not affect the X.25 packets. The Datakit VCS Packet Data Network (PDN) interface module provides the X.25 to Datakit VCS protocol translation so the call can complete on the Datakit VCS network.

A 3B2 computer, called the Destination Server, is used as a network router for calls from the ISDN to the Datakit VCS. All ISDN data calls are routed to the the 3B2 where the user is prompted for security information and desired destination on the Datakit VCS network. The second leg of the call is set up by the Server, the two calls are spliced together (a call transfer takes place) and the Server drops out of the call. See Figure 3 for a diagram of the ISDN - Datakit VCS gateway.

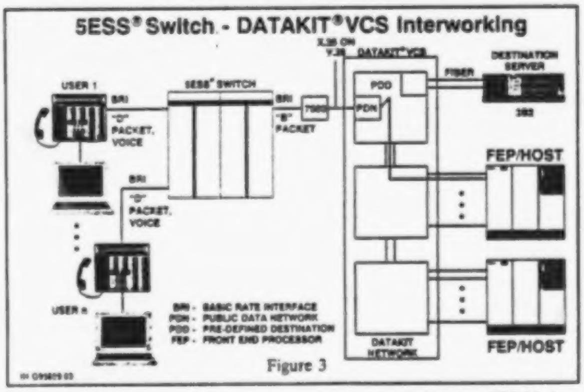
5ESS® Switch - DATAKIT® VCS Interworking
USER 1
BRI
"D" PACKET, VOICE
5ESS® SWITCH
BRI
"B" PACKET
7500
X.25 ON V.35
DATAKIT® VCS
PDD
PDN
FIBER
DESTINATION SERVER
3B2
FEP/HOST
BRI
"D" PACKET, VOICE
USER n
BRI - BASIC RATE INTERFACE
PDN - PUBLIC DATA NETWORK
PDD - PRE-DEFINED DESTINATION
FEP - FRONT END PROCESSOR
DATAKIT NETWORK
FEP/HOST

Figure 3

Asynchronous terminal users are being migrated to ISDN in phases to allow for transparent evolution of applications and data services. Currently, about 20% of the users at Indian Hill are using the ISDN to Datakit VCS gateway for terminal-to-host access.

4.2.2 *Terminal Emulation on Personal Computers*

Users with Personal Computers (PCs) who wish to access UNIX® hosts in a terminal emulation mode have the option of using the communications port of the PC and an ISDN station set with the ADM, as described above, or installing an ISDN PC board in an empty slot on the PC. In general, ISDN PC cards provide a BRI termination on a board installed in the PC and support an adjunct phone connected in a serial manner. These cards provide enhanced data capabilities by accessing the PC bus directly without requiring EIA 232D connectivity. This allows higher speed data connectivity as well as the potential to access the multiple logical channel capabilities of X.25. In addition, telephony control programs on the PC can be used to provide personal speed call directories, menu or icon driven feature selection, and call history logs based on the incoming line identification information. See Figure 4 for an overview of the PC ISDN connectivity methods.

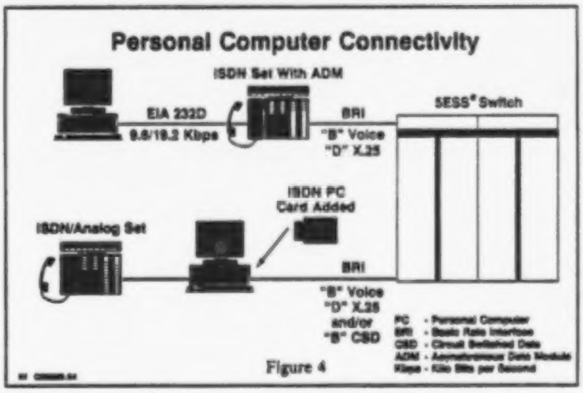
Personal Computer Connectivity
ISDN Set With ADM
EIA 232D
9.6/19.2 Kbps
BRI
"B" Voice
"D" X.25
5ESS® Switch
ISDN PC Card Added
ISDN/Analog Set
BRI
"B" Voice
"D" X.25
and/or
"B" CSD
PC - Personal Computer
BRI - Basic Rate Interface
CSD - Circuit Switched Data
ADM - Asynchronous Data Module
Kbps - Kilo Bits per Second

Figure 4

4.2.3 *PC-to-PC Networking*

PC-to-PC networking is the ability to transfer data directly between PCs without the need for an intermediate transfer to a file server system. PC networking via ISDN can be achieved through software or software and hardware additions to existing PCs.

4.2.3.1 *Software*

Several companies have adapted their PC Local Area Network (LAN) software to use the EIA 232D interface on the AT&T ISDN station sets and the capabilities of ISDN. These software packages provide file transfer, electronic mail, and peripheral equipment sharing across the ISDN data link. It is important to note that all the PCs in the sub-network on the ISDN must support the same file transfer protocol to provide connectivity. See Figure 5 for an example of PC networking using software and the existing communications port.

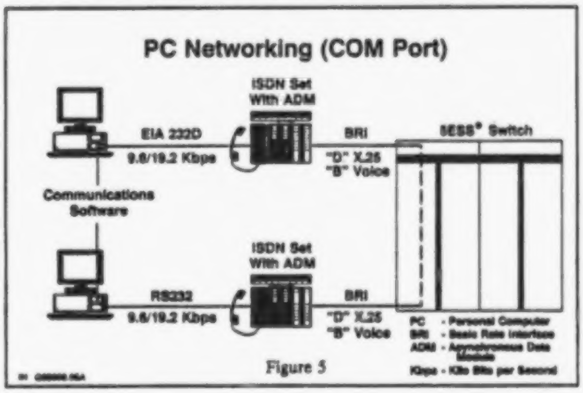
PC Networking (COM Port)
ISDN Set With ADM
EIA 232D
9.6/19.2 Kbps
BRI
"D" X.25
"B" Voice
5ESS® Switch
Communications Software
ISDN Set With ADM
RS232
9.6/19.2 Kbps
BRI
"D" X.25
"B" Voice
PC - Personal Computer
BRI - Basic Rate Interface
ADM - Asynchronous Data Module
Kbps - Kilo Bits per Second

Figure 5

4.2.3.2 *Hardware*

Many ISDN PC cards have the option to provide both terminal emulation for access to host machines and PC networking to other PCs equipped with the same card.

At the Indian Hill complex, we are currently providing only D channel packet switched connections for user access to Datakit VCS and the host computers. However, users with a need to transport many large files between PCs can use a PC card which can support both packet and circuit switched data capabilities. Packet switching is used for small file transfers and access to asynchronous hosts, while circuit switched connections with higher throughput capabilities can be used for large PC-to-PC file transfers. Because the card interfaces with the PC via a direct link to the PC bus, it is not limited to 19.2 kbps by the EIA 232D link. Again, it is important to note that all the PC cards in a sub-network must support compatible networking protocols. See Figure 6 for a representation of PC networking using ISDN PC cards.

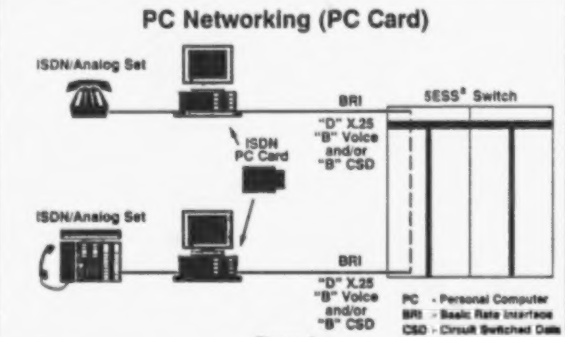
PC Networking (PC Card)
ISDN/Analog Set
BRI
5ESS® Switch
"D" X.25
"B" Voice
and/or
"B" CSD
ISDN
PC Card
ISDN/Analog Set
BRI
"D" X.25
"B" Voice
and/or
"B" CSD
PC - Personal Computer
BRI - Basic Rate Interface
CSD - Circuit Switched Data

Figure 6

4.2.4 *Switched 64 or 56 Kbps Applications*

Facsimile machines have become a piece of office equipment which is almost as common as the coffee pot. Because engineers at Indian Hill are involved in projects across the country and the world, facsimile service for image transfer has become as necessary as the telephone. At Indian Hill, 1200 bps facsimile service is provided by the mail rooms in each building and on department owned machines found in secretarial offices or conference rooms.

At this time it is not feasible to replace all facsimile machines with Group IV systems due to the cost and limited end points which can provide Group IV terminations. However, it is reasonable to begin the migration to Group IV facsimile connectivity to high traffic locations with ISDN capabilities. (e.g., between the IH buildings, Murray Hill, Holmdel, Oklahoma City, the AT&T Network Systems Regional offices, etc.) Networking between the ISDN locations is provided by AT&T ACCUNET® Switched 56 kbps service with access provided by the local operating companies.

Other applications for image transfer are the PictureTel video conferencing, Overview® Scanners or PCs with ISDN cards that support image conferencing across the 64 or 56 kbps link.

The advantage ISDN provides in switched 56 kbps applications is the ability to provide switched access to the ACCUNET network so that those trunks are a shared resource for the Centrex group as opposed to dedicated facilities for each 56 kbps application. In addition, it is much easier and takes less time to make an ISDN line Circuit Switch Data capable than to have a dedicated 56 kbps trunk provided for each user with a 56 kbps application. See Figure 7 for a diagram of switched 56/64 kbps networking.

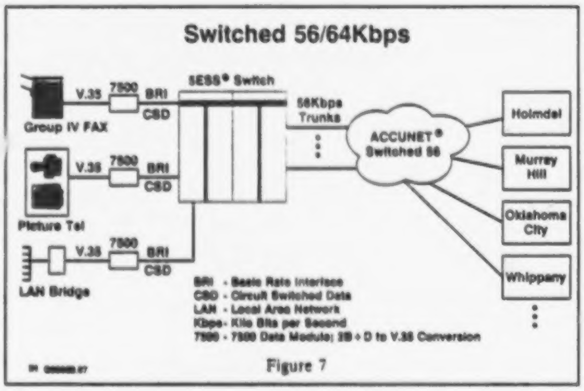
Switched 56/64Kbps
Group IV FAX
V.35
7500
BRI
CSD
5ESS® Switch
56Kbps
Trunks
ACCUNET®
Switched 56
Holmdel
Murray
Hill
Oklahoma
City
Whippany
Picture Tel
LAN Bridge
BRI - Basic Rate Interface
CSD - Circuit Switched Data
LAN - Local Area Network
Kbps - Kilo Bits per Second
7500 - 7500 Data Module; 2B + D to V.35 Conversion

Figure 7

4.3 *ADMINISTRATION*

Several systems are being used or are planned to provide control and monitoring of the service to the Bell Labs Telecommunications group. The AP is providing SMDR information to a centralized system which generates bill back accounting for each line. This service helps us assign costs for usage sensitive resources to the appropriate organizations and monitor for potential misuse of the facilities. In addition, the Traffic Data System (TDS) provides usage information on selected trunk and facilities groups in order to allow evaluation of engineered traffic levels, usage, etc.

Ameritech® Centrex Mate (ACM) is a dial up system which allows our administrators to make changes in the features on the customer's ISDN lines. This allows us to respond to the ever changing environment at Bell Labs (about 60% of the employees change offices each year) with a very quick turnaround time while avoiding the cost of a service order for each change. See Figure 8 for an overview of the administrative systems in use at the IH ISDN Centrex.

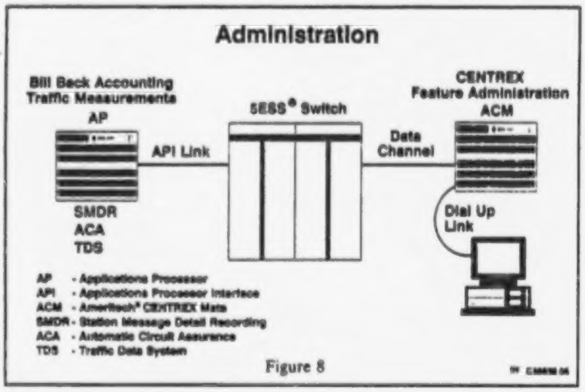
Administration
Bill Back Accounting
Traffic Measurements
AP
5ESS® Switch
CENTREX
Feature Administration
ACM
API Link
Data
Channel
SMDR
ACA
TDS
Dial Up
Link
AP - Applications Processor
API - Applications Processor Interface
ACM - Ameritech® CENTREX Mate
SMDR - Station Message Detail Recording
ACA - Automatic Circuit Assurance
TDS - Traffic Data System

Figure 8

AT&T Bell Laboratories is actively working with IBT to implement the NetPartner™ Network Management System (NMS) which would provide the Bell Labs Telecommunications group access to a subset of the functions available in IBT owned Operations Systems (OS's), e.g., Engineering and Administration Data Acquisition System (EADAS), Switching Control Center System (SCCS), Loop Management Operations System (LMOS), etc. NetPartner is a processor located on IBT premises with data links to the appropriate OSs. A windowing graphics terminal is located on the customer's premises and the system is programmed to provide a graphics display of the customer's portion of the network with associated alarms, trouble reports, etc. The NetPartner system allows the customer's telecommunications personnel an overview of the network, maintenance systems and progress towards the resolution of troubles.

5. IMPLEMENTATION

The implementation of 10,000 ISDN lines, in approximately 2000 line increments is not a job to be entered into lightly. However, the IH ISDN service implementation shows that with enough planning and lead time, it is possible to achieve a wholesale change-out of existing systems with Centrex based ISDN with a minimum of end user disruption and an immediate gain in productivity and cost efficiencies. The service contract was signed and implementation planning begun over a year before the first ISDN lines were cut into service. Orders for station sets and adjunct equipment such as the APs and AUDIX systems were negotiated and placed up to eight months prior to service cut to ensure arrival in time to install the systems for testing. A couple of the planning and implementation activities which were found most helpful are highlighted below.

Probably the most helpful single item implemented prior to the regular service cut was to provide a 30 line test bed into the offices of the Telecommunications group. This allowed the fine tuning of feature assignments, call coverage schemes, data terminal settings, etc. for the IH complex prior to ordering full scale service from the operating company. The Operating Company feature experts worked with the local telecommunications personnel to understand the end user's needs and design the ISDN feature set to meet those needs. In addition, these lines were used to test new applications and Customer Premises Equipment (CPE) as well as providing a hands-on training area for technicians and end user trainers.

An Informix[1] data base system was used to compile and track station review and ISDN set configuration information. By using a data base system the Telecommunications group was able to provide electronic copies of button layouts and feature assignments to IBT for building the line translations on the switch. In addition, because the set layouts for each user were stored in an electronic file, the data base was used to print out individualized button layouts on a laser printer. After cutover, the set configuration data base is used by the telecommunications planners to track day to day moves and station configuration changes as well as printing new labels when required.

End user operation manuals were written specifically for the Indian Hill service so that unique interactions with the local dialing plan and corporate network could be identified and users were provided with information only on features that were available to them. During the week prior to each ISDN service cutover, the end users were provided with a combination of hands on training, auditorium presentations, and videotaped sessions which covered ISDN terminal and feature operations as well as the AUDIX system. Coming as no surprise, the vast majority of "pilot" errors were reported by users that had not attended training.

Furthermore, each building was cutover in a parallel service mode. That is, ISDN phones and lines were installed in each office several days prior to the service cut date. These phones did not provide public network calling, but they did support extension dialing to other ISDN phones in the complex. This allowed testing of the phones and adjunct systems prior to the cut. Most wiring, CO equipment, data base errors and phone related problems were resolved prior to actual service and the actual cutovers seemed almost anti-climatic. At the first building cutover, with about 1600 lines, only 96 operational problems including telephone set failures, incorrect features assigned and no dial tone ("pilot" errors are not included) were reported during the first week of service. The subsequent cutovers were completed with similar success.

6. CONCLUSION

The ISDN service provides the opportunity for many benefits to the Indian Hill community. As discussed earlier, ISDN provides enhanced telephony capabilities including calling name display, integrated voice mail services, and desktop data networking with ubiquitous wiring in each office for data transfer speeds up to 64 kbps. In addition, this installation allows the engineers who design and develop 5ESS Switch ISDN service to work with their own product provided by the local telephone company and learn first hand of its strengths and weaknesses in a real life environment. This can only result in a better and more user friendly product. Finally, the ISDN service at the Indian Hill complex has generated and will continue to generate additional applications and systems designed to interface with ISDN, allowing ISDN to continue to evolve from a new technology to a mature offering with associated support systems and off-the-shelf applications.

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1. Informix is a registered trademark of Informix Software, Inc.

International ISDN Packet Switching: Capabilities, Applications, and Numbering Plan Considerations

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AT&T Bell Laboratories
Naperville, Illinois 60566

This paper describes the issues and concerns that need to be addressed to ensure successful implementation of international ISDN packet switching. This includes the numbering plans, capabilities, and applications of the ISDN packet switching as well as the PSPDN. The paper also discusses the numbering plan interworking solutions - both short-term and long-term - needed for connectivity between ISDN packet switching and PSPDN.

1. INTRODUCTION

1.1 ISDN Deployment Status

ISDN in the United States is well into deployment with individual installations in nearly every major city. AT&T has deployed more than 240 5ESS® Switches that are providing ISDN, and has shipped more than 330,000 ISDN lines on these 5ESS Switches. The Local Administrations have taken various approaches to the deployment of ISDN with some being aggressive, while others are waiting for the availability in late 1990 of the 2B1Q line cards. Regardless, it is apparent that ISDN will become the mainstay for business communications in the United States as we move into the 1990's. As this takes place, companies are already requesting the capability to make end-to-end ISDN calls between their various locations in the United States and in other countries.

At the same time, some Pacific Rim countries are now planning for ISDN service. Australia began ISDN rollout in May, 1989, Japan has had commercial service available since April, 1988, and Singapore had limited service since December, 1988. Hong Kong, Korea, and Taiwan are preparing for trials in 1990 and beyond. In some of these countries, as in the United States, there is emerging demand for end-to-end ISDN connectivity between different locations, both nationally and internationally.

1.2 Need for Trans-Pacific Rim ISDN Interworking

The ability for a Local Administration to meet this customer demand requires them to understand the overall needs of their multi-national customers. This is being addressed as various Local Administrations in the Pacific Rim are beginning to work together on managing their corporate accounts. This will allow the Local Administrations to meet the needs of their customers who have locations in many different countries by offering end-to-end solutions through agreements (yet to be made) with other Local Administrations. This, in itself, will create the need for better Trans-Pacific communication as the Local Administrations must themselves begin to work closer together.

With the complexity of ISDN and the major leap it takes beyond basic telephone services, the issues involved with interconnectivity of ISDN "islands" must be worked with all the service providers. The Local Administrations need to work with the National Administrations and switch vendors to ensure that all the components are in place to provide ISDN Pacific Rim Interworking. This includes Signaling System Number 7 (CCITT Number 7) signaling capabilities and interworking between ISDN packet switching and existing Packet Switched Public Data Networks (PSPDN). This paper will focus on ISDN/PSPDN interworking, specifically the issue of numbering plan interworking.

1.2.1 ISDN / PSPDN Interworking

Interworking ISDN packet switching with packet switching on the Packet Switched Public Data Network (PSPDN) would appear at first glance to be straightforward. After all, ISDN packet switching is similar to packet switching on the PSPDN. Moreover, PSPDNs have been in place for several years, the packet switching protocols are well understood, and there are many vendors and service providers with packet switching products and services.

However, ISDN packet switching uses a numbering plan that is aligned with the typical voice numbering plans as opposed to the traditional PSPDN numbering plan. Therefore, the two numbering plans, ISDN and PSPDN as they exist today, must be interworked by some means. CCITT has set 1996 for a permanent solution for this interworking issue. However, based on the need now for international ISDN connectivity, interim solutions must be addressed.

To better understand the need for ISDN/PSPDN interworking, the PSPDN itself must be understood in terms of its applications, capabilities, and numbering plan. This will be discussed first, and then ISDN packet switching will be explained in terms of its applications, capabilities, and numbering plan. Finally, the interworking of ISDN packet switching and PSPDN will be discussed. This consists of the interim solution, followed by the long-term solution, with the transition plans needed along the way to implement these solutions.

2. PACKET SWITCHED PUBLIC DATA NETWORK (PSPDN)

2.1 Applications

The use of PSPDN since its conception in the early 1970s has had an steady growth rate and even today is forecasted to grow at an annual rate of 17 percent through 1993 in the United States[1]. Packet switching is well suited for data applications that have the following characteristics: short bursts of data followed by long periods of inactivity, rapid exchanges of short messages, geographically dispersed locations of connectivity, and insensitivity to short delays. Some examples of typical packet switching applications are discussed below.

A user on an X.25 terminal or Personal Computer (PC) can remotely access a host computer by placing a packet switched data call. The user can remain connected to the host for an extended period of time without having to be concerned about incurring a large bill for the connect time, because billing for packet switching is primarily volume sensitive with a nominal charge for connect time.

The business office and retail environments are also areas where packet switching has many uses. Electronic mail, point-of-sale transactions, credit card verification, electronic financial services, telex, computer bulletin boards, and Wide Area Networks are all applications used today and are supported by packet switching.

2.2 Capabilities

Packet switching allows segments (packets) of data to be sent from one user to another user with call control instructions attached to the beginning and end of the data being sent. This allows the "packet" of data to work its way through the network without requiring the dedication of network resources for the duration of the call. This allows optimal use of valuable network resources, therefore reducing the price.

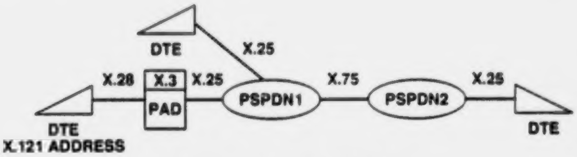
Connection to and protocols supported in the packet switching arena vary with the vendor offering the service. The various protocols governing the packet switching interface and numbering plan are listed below in Table 1.

PSPDN Interface and Numbering Plan Protocols	
X.121	Numbering Plan for Public Data Networks[2].
X.25	Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to Public Data Networks by dedicated circuit[3].
X.28	DTE/DCE interface for a start-stop mode Data Terminal Equipment accessing the Packet Assembly/Disassembly facility (PAD) in a Public Data Network situated in the same country[3].
X.29	Procedures for the exchange of control information and user data between a Packet Assembly/Disassembly (PAD) facility and a packet mode DTE or another PAD[3].
X.3	Packet Assembly/Disassembly (PAD) facility in a Public Data Network[3].
X.32	Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and accessing a Packet Switched Data Network through a Public Switched Telephone Network or an ISDN or circuit switched Public Data Network[3].
X.75	Terminal and Transit Call Control Procedures and Data Transfer System on International Circuits between Packet Switched Data Networks[2].

TABLE 1

The type of connection and speed available are usually inter-related. Public dial-up is at 1200 bps, 2400 bps, and 4800 bps, private dial-up is at 9600 bps and 19.2 Kbps, and dedicated connections are at 19.2 Kbps and 56 Kbps.

Figure 1 below illustrates the use of these protocols in a packet switched network.

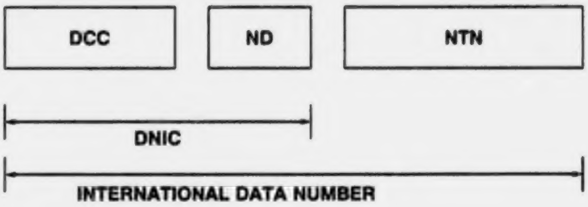


PSPDN PROTOCOLS
FIGURE 1

2.3 Numbering Plan

The PSPDN numbering plan is governed by CCITT Recommendation X.121 [4]. X.121 applies to Public Data Networks (PDN) in general, where PDN includes both packet switched and circuit switched data networks. PSPDN is a sub-set of PDN, the distinguishing feature being that PSPDN is based solely on packet switching.

The structure of an X.121 number is shown below in Figure 2:



DCC - **Data Country Code (3 Digits)**
ND - **Network Digit (1 Digit)**
NTN - **Network Terminal Number (1 to 10 Digits)**
DNIC - **Data Network Identification Code (4 Digits)**

CCITT X.121 NUMBER STRUCTURE
(PSPDN NUMBERING PLAN)
FIGURE 2

DNIC is the four digit Data Network Identification Code used to identify the particular network. CCITT allocates DNICs to each country, based on the size of the country and the need for network identification codes. The initial digit of a DNIC is in the range 2 through 7, and the subsequent digits are in the range 0 through 9. The exception to this rule is in a Maritime Mobile Network, whose DNIC is in the range 1111 through 1114.

NTN is the Network Terminal Number, and it can be from one to ten digits long. It is used to identify the terminal equipment on the network. Each digit of the NTN can be in the range 0 through 9. The assignment of NTN to a terminal is a network matter.

Together, the DNIC and the NTN comprise the X.121 address and uniquely identify an end-point on a PSPDN, and are used to route a packet call to its destination.

3. ISDN PACKET SWITCHING

3.1 Applications

ISDN packet switched data applications include terminal-to-host sessions, host-to-host sessions, electronic mail, PC-to-PC file transfer, and PC-to-host computer file transfer. While these applications can be done via the regular PSPDN, the benefit provided by the Integrated Services Digital Network is the "integration" of packet switching and circuit switching over one line to the user. Therefore, the user no longer needs two separate lines into an office or residence for simultaneous voice and data. This makes possible economical access to the PSPDN for the small business and residential subscriber.

There are several everyday examples where this can be beneficial. With the appropriate applications software on the customer premises, two users at separate ISDN locations can have a telephone conversation and be simultaneously reviewing or editing the same document on their PCs. This will allow them both to view the same document and observe changes as they are made from either PC. Another application where this can be used today is in remote learning where PCs are used. With an ISDN line coming into a classroom, one "B-channel" can be used for a voice call and the "D-channel" can be used for multiple, simultaneous packet switched data calls by different PC users. (Note: Up to eight different ISDN users can use the D-channel of one ISDN line at a time for packet switching access. This is possible through a capability known as point-to-multipoint connection supported by the ISDN BRI). This would allow the instructor to use a speaker phone to communicate to the whole class, while allowing individual monitoring and data communication through each student's PC.

When ISDN comes into the residential market, one of the applications will be for an employee who works at home. One possible example of this application is discussed below. It involves an employee who has been relocated to another country and is now can easily work at home to keep in better contact with their home office. Since time differences between countries are a fact of life, especially in the Pacific Rim, employees prefer to work from their home for convenience. Using one "B-channel" for voice and the other "B-channel" for data on the PC using packet switching, a person can easily work from home. This application can also be applied to the student, in one country who wants to take a remote class offered in another part of the world.

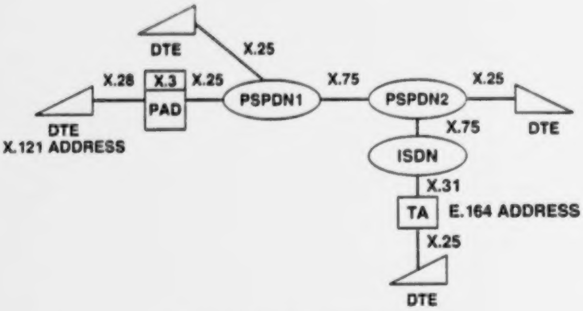
3.2 Capabilities

ISDN allows packet switching on the B and D channels, at channel speeds up to 64 Kbps and 16 Kbps, respectively. The various protocols governing the ISDN packet switching interface and numbering plan are listed below in Table 2.

ISDN Interface and Numbering Plan Protocols	
E.164	Numbering Plan for the ISDN Era[5].
X.25	Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to Public Data Networks by dedicated circuit[3].
X.31	Support of packet mode terminal equipment by an ISDN[3].
X.75	Terminal and Transit Call Control Procedures and Data Transfer System on International Circuits between Packet Switched Data Networks[2].

TABLE 2

Figure 3 below illustrates the use of these protocols in a packet switched network.



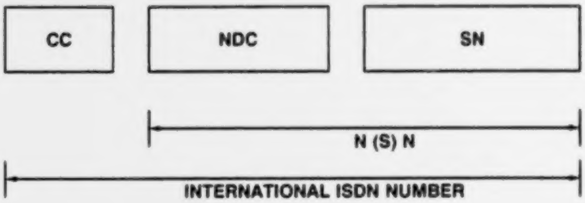
ISDN/PSPDN PROTOCOLS
FIGURE 3

The X.31 protocol allows an X.25 DTE on an ISDN line to access the packet handling function, which could be resident either in the ISDN or the PSPDN. If X.31 is needed to access the packet handling function in the ISDN, then interworking between ISDN and PSPDN will be required. This paper focuses on such an access, and the related numbering plan issues.

3.3 Numbering Plan

CCITT E.164 specifies the numbering plan for the ISDN era[5]. E.164 applies to both circuit switched and packet switched services on the ISDN, be they voice or data. The idea of a single numbering plan for the whole range of ISDN services is in keeping with an important goal of ISDN, which is to provide the ISDN user with an integrated access and an integrated view of the whole network.

The structure of an E.164 number is shown below in Figure 4:



CC - Country Code (1 to 3 Digits)
NDC - National Destination Code
SN - Subscriber Number
N(S)N - National Significant Number
Maximum Length of International ISDN Number:
- 12 Digits Until Time T (Dec. 31, 1996)
- 15 Digits Beyond Time T

CCITT E.164 NUMBER STRUCTURE
(ISDN NUMBERING PLAN)
FIGURE 4

CC is the Country Code, which is assigned by CCITT. It can be from one to three digits long. The initial digit of the country code will be in the range 1 through 9, but the subsequent digits can be in the range 0 through 9. Since there is an upper limit to the total length of an E.164 number, the larger countries are usually assigned a shorter country code, to accommodate longer subscriber numbers.

NDC is the National Destination Code. It is analogous to the DNIC in an X.121 number, in that it is used to identify a geographical region or network within the country. The difference is that the NDC is a nationally assigned code, whereas the DNIC is allocated by the CCITT.

SN is the Subscriber Number, and like the NTN, it identifies the end point or network termination. Like the NDC, the assignment of subscriber numbers is a national matter.

The NDC and the SN together comprise the N(S)N. N(S)N is the National (Significant) Number, and as its name suggests, it has significance only within the nation, and is a national matter.

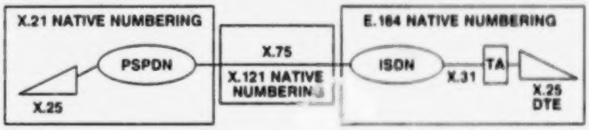
E.164 does not impose any explicit length requirements either on the NDC, SN, or N(S)N. However, E.164 does impose restrictions on the length of the Country Code (CC), and the maximum length of the E.164 number. The length of the country code can range from one to three digits. The maximum length of the E.164 number is limited to 12 digits until CCITT defined Time T, which is December 31, 1996[4]. The reason for this limit is to allow interworking between Public Switched Telephone Network numbers and ISDN numbers in the interim. Beyond 1996, the maximum length of an E.164 number can be up to 15 digits, though there is no requirement that countries adopt the increased length.

4. ISDN / PSPDN Numbering Plan Interworking

With the deployment of packet switching on ISDN, ISDN/PSPDN interworking is needed to allow the packet users on ISDN to communicate with the packet users on PSPDNs. Since the numbering plans used by ISDN and PSPDNs are different, CCITT has recommended an interim solution and a long term solution to the numbering plan interworking problem. The interim solution is based on the use of an Escape Code (the decimal digit 0, or 9 in some instances) in the calling and called address fields, and is valid until Time T (December 31, 1996). The long term solution, which is the recommended interworking solution beyond Time T, is based on an expanded address block in the X.25 packet, and is called the Address Block Solution. The Escape Code Solution and the Address Block Solution are discussed in the following sections.

4.1 Interim Solution (Escape Codes)

To address the issue of ISDN/PSPDN numbering plan interworking until Time T, CCITT has defined an interim solution based on Escape Codes. The interim interworking solution can be explained through the following model. Figure 5 below contains a diagrammatic representation of this model.



DTE = Data Terminal Equipment
TA = Terminal Adapter

INTERIM SOLUTION: CONCEPTUAL MODEL
FIGURE 5

Take a network and conceptually divide it into ISDN and PSPDN segments or sub-networks. Think of each ISDN segment as a domain in which the native numbering plan is E.164. Think of each PSPDN segment as a domain in which the native numbering plan is X.121. In some instances, the whole network may be ISDN or PSPDN. In such cases, the whole network can be considered as a domain with one native numbering plan - E.164 if ISDN, X.121 if PSPDN. The packet access interfaces (X.31 in ISDN, X.25 in PSPDN) belong to the same domain as the network they are connected to. The X.75 inter-network interface can be thought of as a domain in itself, whose native numbering plan is determined as follows:

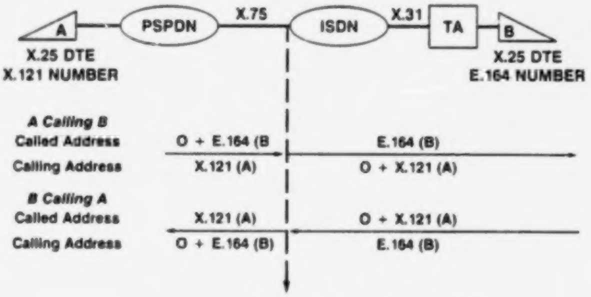
- If one or both networks being connected by the X.75 interface are PSPDNs (i.e., X.121 based numbering), then the native numbering plan on the X.75 interface is X.121.
- Otherwise (i.e., both networks are ISDN, which means they both use E.164 numbering), then the native numbering plan on the X.75 interface is E.164.

Therefore, a domain can be a whole network, a sub-network, or an X.75 interface between two networks. Each domain will have one native numbering plan, either E.164 or X.121, for the entire domain.

Having defined the rules by which the native numbering plan of a domain can be established, an unambiguous way of identifying and interworking the different numbering plans is required, since both native and non-native numbers can traverse a given domain. The CCITT-defined Escape Codes provide this unambiguous method of identifying and interworking the different the numbering plans.

When a packet call set up is initiated, call setup / call clearing packets (e.g., Call Request, Call Connected, Incoming Call, Call Accepted, Clear Request) will be transmitted between the access interfaces and the serving networks, across the serving networks, and between the serving networks. These packets will contain calling and called address fields and will traverse domains whose native numbering is either E.164 or X.121. If the calling or called address field contains a number whose numbering plan is different from the numbering plan of the domain being traversed, then CCITT recommends the use of an Escape Code (the single decimal digit 0, or 9 in some instances) in front of the calling or called address. The Escape Code signifies an "Escape" from the native numbering plan applicable to that domain, indicating that the number belongs to a different numbering plan.

For instance, consider a packet call from a PSPDN to an ISDN, as illustrated below in Figure 6.



CCITT ESCAPE CODE SOLUTION
FIGURE 6

The native numbering plan on the PSPDN is X.121, the native numbering plan on the ISDN is E.164. The native numbering plan on the X.75 interface connecting the PSPDN to the ISDN will be X.121.

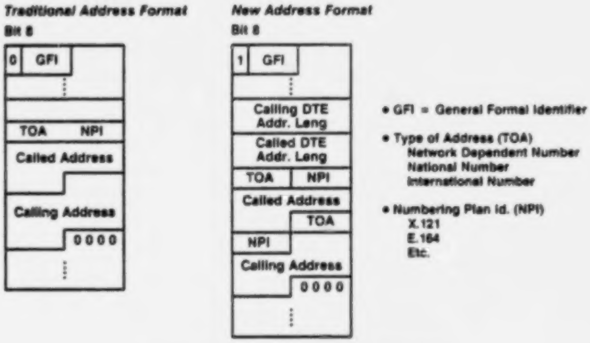
- The calling address in the Call Request Packet (CRP) will be in the native X.121 format (DNIC+NTN), from the user interface through the PSPDN, up until the point it enters the ISDN. When it enters the ISDN, it will be prefixed with the escape code 0. On the X.75 interface, and within the PSPDN, the calling address will be carried in the native X.121 format.
- Since the called address is an E.164 number, it will be carried with the escape code 0 (i.e., 0+CC+N(S)N) in the Call Request packet, from the user interface through the PSPDN, up until the point it enters the ISDN. When it enters the ISDN, the escape code 0 will be deleted, and the address will be transmitted in the native E.164 format (CC+N(S)N).

Figure 6 also illustrates the calling/called address formats in the Call Request packet for a call from an ISDN to a PSPDN.

4.2 Long Term Solution (Address Block Solution)

The long term solution, which is the recommended interworking solution beyond Time T, is based on an expanded address block in the X.25 packet, and is called the Address Block Solution. The Address Block Solution is documented in CCITT X.25[3].

Figure 7 below contains the new format of the X.25 address block, as illustrated in the 1988 CCITT X.25 Recommendation.



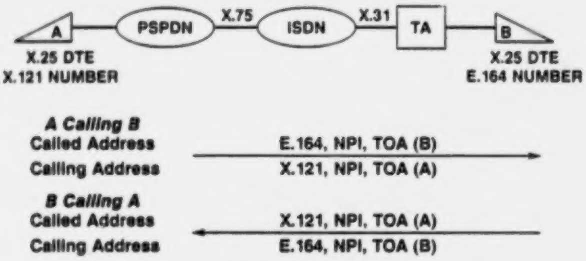
Traditional Address Format
Bit 8
0
GFI
TOA
NPI
Called Address
Calling Address
0000
New Address Format
Bit 8
1
GFI
Calling DTE Addr. Leng
Called DTE Addr. Leng
TOA
NPI
Called Address
TOA
NPI
Calling Address
0000
• GFI = General Formal Identifier
• Type of Address (TOA)
Network Dependent Number
National Number
International Number
• Numbering Plan Id. (NPI)
X.121
E.164
Etc.

ADDRESS BLOCK SOLUTION
FIGURE 7

The first two fields in the address block, namely, the Calling DTE Address Length field and the Called DTE Address Length field, have each been expanded to one octet (whereas previously they were each half an octet long). This has been done to accommodate longer addresses, which may become necessary in the future. E.164 numbers will have 15 digits beyond Time T, and many countries have already expressed the need for this, because of the demand foreseen for ISDN directory numbers. Projecting this demand into the future, it is not inconceivable that even longer addresses will be needed in the future. Therefore the address block has been expanded to provide the protocol frame-work for longer addresses.

Another goal of the Long Term Solution is to separate the issue of addressing from the issue of the numbering plan interworking, by explicitly identifying the numbering plan and the type of address. Although the Interim Solution affords an unambiguous way of identifying E.164/X.121 numbers and interworking the two, it is unwieldy and cumbersome because it involves prefixing and deletion of escape codes; moreover, the interim interworking solution is limited to a few different numbering plans (E.164, X.121). The Address Block Solution introduces two new fields called Numbering Plan Identifier / Type Of Address (NPI/TOA). There is one NPI/TOA field associated with the calling address and another NPI/TOA field associated with the called address. The NPI portion identifies the numbering plan (E.164, X.121, etc.) of the calling or called address, respectively. Since it is half an octet long, it can potentially identify 16 different numbering plans. The TOA field indicates whether the address is network dependent, national, international, etc. Since the Address Block Solution does away with escape codes, it frees up more digits for use in addressing.

Figure 8 below illustrates the use of the new NPI/TOA fields in the address block, for the case of a call from a PSPDN to an ISDN.



A
PSPDN
X.75
ISDN
X.31
TA
B
X.25 DTE
X.121 NUMBER
X.25 DTE
E.164 NUMBER
A Calling B
Called Address
E.164, NPI, TOA (B)
Calling Address
X.121, NPI, TOA (A)
B Calling A
Called Address
X.121, NPI, TOA (A)
Calling Address
E.164, NPI, TOA (B)

CCITT ADDRESS BLOCK SOLUTION
FIGURE 8

Again, the native numbering plan on the ISDN is E.164, and the native numbering plan on the PSPDN is X.121. The native numbering plan on the X.75 interface connecting the ISDN to the PSPDN will be X.121. The advantage of this method is immediately evident from the figure, in that there is no change to any of the fields in the address block as the Call Request Packet (CRP) travels from the calling user to the called user. This results in a simple and straightforward scheme for mapping addresses between X.25 and X.75 packets.

Figure 8 also illustrates the use of the long term interworking solution for a call from an ISDN to a PSPDN.

4.3 Transition Plans

Whenever a new standard has to be implemented, one of the biggest concerns for vendors (switch, Customer Premises Equipment, Operations Support Systems, etc.) and service providers alike is how to effect the transition from the "old" to the "new." In principle, the transition could be done either on a flash-cut basis or in a phased manner. The two approaches are discussed in detail later. Irrespective of the approach adopted, the following steps are required for a successful transition:

- Since the new standard involves a change in the X.25 packet format, Customer Premises Equipment (CPE) must be upgraded.
- If customer dialing procedures are impacted, then the service provider must advise and educate the customers appropriately.

- The network nodes (switches) must be upgraded to support the Address Block Solution.
- All the Operations Support Systems (OSS) impacted by this change must be modified to handle the new standard.

While the steps listed above apply equally to the flash-cut and the phased approaches to transition, the difference is that:

- Timing is critical in the flash-cut scenario, and it requires much coordination.
- The phased approach requires less coordination, but since the old and the new standards can co-exist in the network, the network elements need to be able to support both modes of interworking simultaneously.

4.3.1 Flash-Cut Approach

The flash-cut approach will require "instantaneous" cut-over from the old mode of interworking (Escape Codes) to the new mode of interworking (Address Block Solution). This requires that all the networks affected by this transition are capable of supporting the new standard, before the cut-over can be done.

The product releases (switch, CPE, OSS, etc.) that support the new standard must ensure that they can continue to work in the "old" mode until the point of cut-over, at which time they should start working in the "new" mode. The network administrators for the various service providers must work closely and coordinate the flash-cut in a way that ensures no or minimal service disruption.

The need for close coordination makes this approach complicated. Another disadvantage to this approach is that the implementation of the new standard could be delayed, because all the elements in all the networks must be upgraded before the cut-over can be done.

4.3.2 Phased Approach

The phased approach to transition is different from the flash-cut scenario in that the cut-over does not have to happen at the same time across all the networks. The network administrators will each be responsible for their individual networks, and they will have the flexibility to accomplish the conversion on a nodal basis, sub-network basis, or network basis.

While this approach simplifies the issue from the network administrator's perspective, by eliminating the need for global coordination, it now places added burden on the various products (switches, CPE, OSS, etc.) of having to simultaneously support both the old and the new modes of interworking until the transition is complete. The advantage of this approach is that it is more manageable, and provides the networks some flexibility in implementing the new standard. Furthermore, if things do not work right, the option exists to revert to the old mode of interworking until the problem can be fixed.

5. Summary

ISDN has emerged as the communications platform on which all future services will be based. Across the Pacific Rim Local Administrations are planning for ISDN and its interworking, in anticipation of customer demand for interworking of their ISDN applications between their different locations. The ability to provide this interworking will depend on the availability of CCITT Number 7 signaling and ISDN/PSPDN interworking. This paper discussed the numbering plans on ISDN and PSPDN, and the interworking between the two.

CCITT has proposed interim and long-term solutions to the numbering plan interworking issue. The interim solution is based on an Escape Code (the decimal digit 0, or 9 in some instances) used in front of the calling and called addresses whenever a call is placed between the two numbering plans (E.164 and X.121). This leading digit tells the E.164 or X.121 domain to expect a different type of address and to treat it accordingly. The long term approach, which is recommended for use beginning after December 31, 1996, consists of an expanded address block in the X.25 packet and is called the Address Block Solution. This consists of two new fields called Numbering Plan Identifier / Type Of Address (NPI/TOA). The NPI identifies the numbering plan used, and the TOA indicates the type of network address.

6. Conclusion

The integration of ISDN packet switching with the existing PSPDN requires a transition that is smooth and transparent to the end user. All of us need to be thinking about ways to achieve the necessary solutions. This will require ongoing dialogue among all the interested parties. The United States is planning for a flash-cut to Escape Codes in August, 1990. As other countries prepare to go to Escape Codes, using either a flash-cut or phased approach, forums such as this should be used to announce and detail these plans. Even as we speak of the implementation of Escape Codes, we all know that Time T (December 31, 1996) is not too far away. Therefore we need to begin addressing the issue of how we plan to transition to the long term interworking solution (Address Block solution).

The flash-cut and phased approaches both have their advantages and disadvantages, and there are scenarios in which each would be appropriate. Considering all the factors, it appears that a combination of the two approaches maybe needed to achieve the transition on a global level. The flash-cut could be used within a country, because it is possible to control and coordinate such an activity at this level. However, the complexity of a flash-cut is greatly magnified on an international level, and therefore a phased approach will work better. This points to the need for everyone's involvement and an ongoing dialogue as the various countries determine their national transition plans.

REFERENCES

1. The Eastern Management Group, "Packet Switching", July 1988.
2. CCITT Bluebook, Volume VIII, Fascicle VIII.3, 1988.
3. CCITT Bluebook, Volume VIII, Fascicle VIII.2, 1988.
4. International Numbering Plan for Public Data Networks, CCITT Recommendation X.121, Blue Book, Fascicle VIII.4, 1988.
5. CCITT Bluebook, Volume VII, Fascicle VII.2, 1988.

Personal Computer Communication Network System over ISDN

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ABSTRACT

Nippon Telegraph and Telephone Corporation (NTT) is further developing a Personal Computer Communication Network System (PCN) toward its enhancement of interconnectibility. This system conforms to CCITT recommendation X.400 series for Message Handling Systems (MHS). The NTT-PCN commercial service, which was introduced by an NTT's subsidiary company, provides mail box, bulletin board, and other communication services, mainly for personal computers (PCs).

This paper describes NTT-PCN and its operation. The necessity for the PCN to interwork with Integrated Services Digital Network (ISDN), an outline of a PC communication protocol for ISDN, and a PC communication service over ISDN are also discussed.

1. INTRODUCTION

Nippon Telegraph and Telephone Corporation (NTT) is further developing a Personal Computer Communication Network System (PCN)[1][2] toward its enhancement of interconnectibility. To enhance the interconnectiblity of PCN with other MHSs, NTT has participated in various events such as the exhibition of X.400 interworking implementation at Telecom '87 in Geneva, the OSI demonstration at INE '88 in Tokyo, and the demonstration of interworking among MHSs at Telecom Japan '89 in Tokyo.

The NTT-PCN commercial service[3] was introduced by an NTT's subsidiary company in 1986. The service was upgraded in 1987. The NTT-PCN provides mail box, bulletin board, and other communication services, mainly for personal computers (PCs), conforming to CCITT recommendation X.400 series for Message Handling Systems (MHS).

NTT started a 2B+D (192 Kb/s line rate) commercial Integrated Services Digital Network (ISDN) circuit-switched service, called INS Net 64 in April 1988, and a 23B+D (1.544 Mb/s line rate) circuit-switched service, called INS Net 1500 in June 1989. As ISDN services advance, various applications over ISDN are developed.

MHS service for PCs is considered to offer a great potential application over ISDN. NTT has proposed the standardization of a PC communication protocol for ISDN to the Telecommunication Technology Committee (TTC) in Japan.

This paper overviews the NTT-PCN system and operation, and describes the need for the PCN to interwork with ISDN, outlines a PC communication protocol for ISDN and an implementation of the PC communication protocol, and describes a PC communication service over ISDN.

2. OVERVIEW OF NTT-PCN

2.1 NTT-PCN SERVICES

- Mail Box Service (MBS)

The mail box service provides all basic service items and 40 option items defined by the CCITT X.401 Recommendation, including multi-destination delivery, receipt notification, and code/ media conversion.

- Bulletin Board Service (BBS)

The bulletin board service provides a storage facility in the system to enable BBS users to write and read messages.

- Real Time Connection Service (RTS)

The real time connection service provides direct communication between originators and recipients, for example, access to information provider centers (IPs), and multipleconnections for real time conferences.

- Additional Services

A direct delivery service is provided to reduce message delivery delay. Conversion services are provided to enable communication among different character-based terminals and from character-based terminals to G3 facsimile terminals.

- Security

Security is provided by authentication with password and identification, closed user groups which permit communication only among pre-registered members, and notification of the last access time.

2.2 NETWORK SYSTEM STRUCTURE

The network system structure of NTT-PCN is shown in Figure 1. To achieve economical PC communication, NTT-PCN provides access points for PCs through the public telephone network. PCs located near NTT-PCN Center are directly accommodated by the center, and PCs located far distant from the center are accommodated by distributed line concentrating equipment through packet switched network or leased lines. The information provider centers and other value added systems, including private MHSs are accommodated through packet switched network or leased lines.

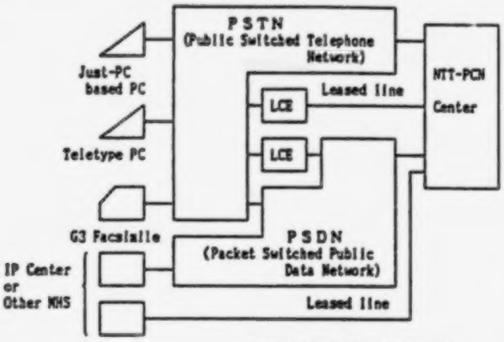
2.3 PROTOCOL STRUCTURE

NTT-PCN supports PCs conforming to Japanese Unified Standard for Telecommunication Personal Computers (JUST-PC)[4], teletype PCs, and G3 facsimiles (used only for output). The protocol structure of the NTT-PCN is shown in Table 1. It is based on the Open Systems Interconnection (OSI) reference model.

3. OPERATION OF NTT-PCN

3.1 NETWORK CONFIGURATION

The network configuration of NTT-PCN is shown in Figure 2. Two NTT-PCN centers are installed in Tokyo. Access points extend to 7 main cities including Tokyo, and to 13 prefectural capitals. The access points located in the 6 main cites (excluding Tokyo) are provided by line control equipment (LCE) connecting to the two centers in Tokyo through 80 Kb/s leased lines. The other access points are provided by small-scale LCE connecting to the nearest LCE through 9.6 Kb/s leased lines .



LCE: Line Control Equipment
JUST-PC: Japanese Unified Standard for PC Telecommunication

Figure 1 Network system structure of NTT-PCN

Table 1 Protocol Structure

Layer	PSPDN	PSPDN/Leased Line	PSTN		
	Other MHSs	IP Center	JUST-PC based PC	Teletype PC	G3 Facsimile
7	X.411, X.420 X.410	Mail Box, Bulletin Board, Real Time Connection, Code/Media Conversion, etc.			
6	X.409		JUST-PC ↓	IA5, JIS.X0201 JIS.X0208, Shift JIS	MH,MR
5	X.225(BAS)	X.225(BCS)	X.225(BCS)	Teletype Access Protocol	T.30 binary code procedure
4	X.224 Class 0		X.224 Class 0		
3	X.25		T.70		
2	X.25 LAPB		LAPB+T.71(HDTM)		
1	X.25 Physical		V.27 ter.	V.21/22	V.21/27ter./29

JUST-PC: Japanese Unified Standard for PC Telecommunication
JIS: Japanese Industrial Standards
BAS: Basic Combined Subset
BCS: Basic Actibity Subset
LAPB: Link Access Protocol Balanced
HDTM: Half-Duplex Transmission Module

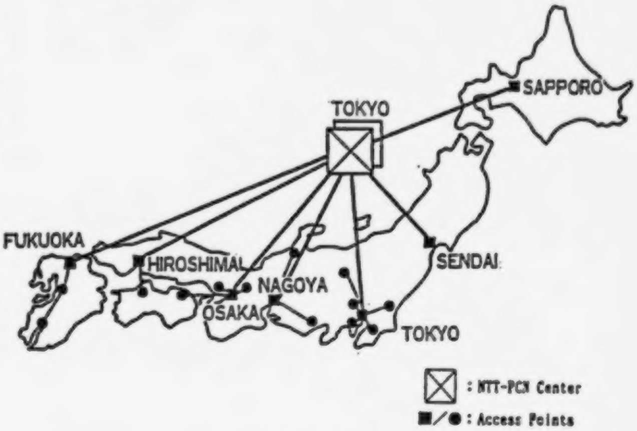


Figure 2 Network configuration of NTT-PCN

3.2 OPERATIONAL DATA

(1) Daily traffic
The daily traffic distribution is shown in Figure 3. This is an average traffic distribution of a weekday. There is almost no deviation among traffic distributions of weekdays from the average one, because NTT-PCN is mainly used for business.
(2) Requested Services
The requested services distribution is shown in Figure 4. The bulletin board service (BBS) accounted for most of the demand according to the survey of 19..3[3]. Recently, requests for mail box service (MBS) have been increasing.

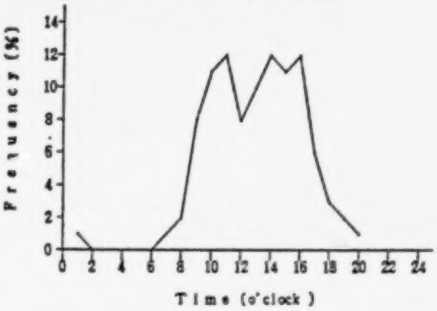


Figure 3 Daily traffic distribution

BBS	RTS	MBS
(36 %)	(36 %)	(28 %)

BBS: Bulletin Board Service
RTS: Real Time Connection Service
MBS: Mail Box Service

Figure 4 Distribution of daily requested services

(3) Communication Duration and Message Length
The communication duration distribution is shown in Figure 5. It shows that about 80 percent of communications are finished within 8 minutes, and the longest communication takes 136 minutes. The average communication duration is about 8 minutes, which is twice as much as that of 1988. The message length distribution is shown in Figure 6. The average of message length transferred for BBS is 10 KBytes, and 29 KBytes for MBS, while in 1988 that for BBS was 4 KBytes, and 11 KBytes for MBS. The longest message is 256 Kbytes.

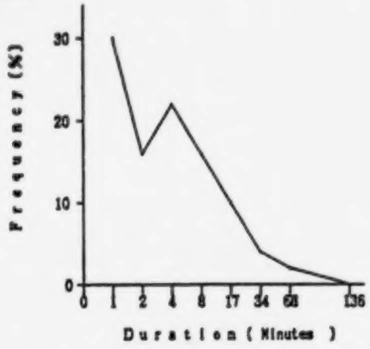


Figure 5 Communication duration distribution

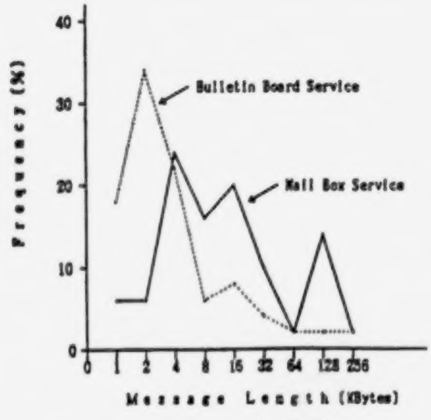


Figure 6 Message length distribution

3.3 REQUIREMENTS

These results show a trend for increasing message lengths and the communication duration due to large volume message and conversational procedure. The communication duration can be reduced by increasing the transmission speed. To meet this requirement, PCN will use high-speed modems such as 2400 bps V.22 bis modems, MNP (Microcom Networking Protocol) modems, and 9600 bps V.32 modems among others, in addition to the existing JUST-PC adapters (4800 bps V.27 ter. modems), 300 bps V.21 modems, and 1200 bps V.22 modems. There will be problems for PCN to accommodate PCs with various kinds of modems because there are many differences in error-correction procedures (MNP, LAPM, etc.) and communication control procedures including modem control. As ISDN service advances, various kinds of terminal adapters (TAs) are being developed for PCs to interconnect with ISDN. Although TAs are a little high in price at present, they will have possibility of replacing existing modems by reduction in price in the near future. Thus to cope with accommodation of TA-based PCs, PCNs should interwork with ISDN, which provides highly reliable high-speed transmission and unified interface.

4. ISDN-PC COMMUNICATION PROTOCOL

4.1 BACKGROUND

Conforming to CCITT recommendation I series, national ISDN protocol standards in Japan were specified by TTC in May 1987. NTT started commercial ISDN service in April 1988, conforming to the international and national ISDN protocol standards. Recently, the rapid development of LSI products used for ISDN interface has allowed various kinds of ISDN terminals and TAs to be marketed. Application Services that operate over ISDN are being developed by using the ISDN terminals and TAs. The number of PCs in use is rapidly increasing and PCs are becoming more powerful. Although 16-bit PCs are mainly used at present, 32-bit PCs are expected to become dominant in the near future. In line with the increase in the number of PCs, the number of users of PCN services is increasing. As mentioned in the previous chapter, PCN needs to interwork with ISDN to provide highly reliable high- speed transmission and reduce communication durations. The MHS service in PCN is considered to offer a great potential application service over ISDN. It is becoming important to standardize PC communication protocol over ISDN for interconnectibility . NTT has proposed a PC communication protocol over ISDN, named ISDN-PC communication protocol, to TTC, and standardization of the ISDN-PC communication protocol is proceeding.

4.2 CONSIDERATIONS ON STANDARDIZATION

The scope of ISDN-PC communication protocol specified is the protocols from layer 1 to layer 7, based on the OSI reference model. The ISDN-PC communication protocol is applicable widely to various useful services (MHS, DIR, FTAM, etc.) over ISDN.

4.3 ISDN-PC COMMUNICATION PROTOCOL STRUCTURE

We propose four structures for ISDN-PC communication protocol as shown in Figure 7, considering the communication types of center to center and center to end, and operation modes of normal and X.410 (1984 version) specified in X.227.
-Type (A): the common profile for various services (MHS, DIR, FTAM, etc.), conforming to OSI protocol.
-Type (B): the profile for MHS functional standards specified by TTC.

-Type (C): the profile for the 1988 version MHS to support Message Transfer Protocol(P1).
-type (D): the profile for JUST-PC application.
Any set of the lower profiles (layers 1 to 4) and any set of the higher profiles (layers 5 to 7) can be combined. The protocols from layers 1 to 4 are based on the TTC functional standard JT-T.90 for interconnection among ISDN-G4 facsimiles.

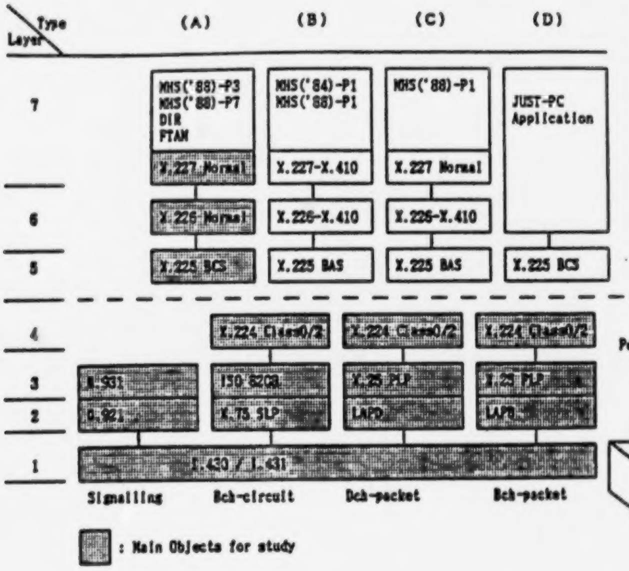

Type
Layer
(A)
(B)
(C)
(D)
7
6
5
4
3
2
1
MHS('88)-P3
MHS('88)-P7
DIR
FTAM
X.227 Normal
X.226 Normal
X.225 BCS
MHS('84)-P1
MHS('88)-P1
X.227-X.410
X.226-X.410
X.225 BAS
MHS('88)-P1
X.227 Normal
X.226-X.410
X.225 BAS
JUST-PC
Application
X.225 BCS
X.224 Class0/2
X.224 Class0/2
X.224 Class0/2
I.931
Q.921
ISO 8208
X.75 SLP
X.25 PLP
LAPD
X.25 PLP
LAPB
I.430 / I.431
Signalling
Bch-circuit
Dch-packet
Bch-packet
: Main Objects for study

Figure 7 ISDN-PC communication protocol structure

4.4 IMPLEMENTATION OF ISDN-PC COMMUNICATION PROTOCOL

The key point in implementing the ISDN-PC communication protocol is to offer high-speed data transmission, for example, 9.6Kb/s D-channel packet and 64Kb/s B-channel circuit or packet, and to reduce processing load on PCs because of the adoption of OSI protocol. These requirements can be met by using a PC-board with an embedded microprocessor, which has an ISDN connecting function up to layer 3 and possibly up to higher layers within capability. An implementation of ISDN-PC communication protocol is shown in Figure 8. This implementation is structured by placing most functions on the PC-board and offering a universal interface, where application on PCs can indicate any facility of transmission mode of D-channel packet and B-channel circuit or packet up to layer 3, transport layer, and session layer.

4.5 PC COMMUNICATION SERVICE OVER ISDN

The communication between a PC and a PCN center includes a conversational procedure and a message transfer procedure. The conversational procedure treats commands, which are a relatively small volume of information in transmission, and wastes time in communication because of the waiting time responses in half-duplex processing. The use of ISDN D-channel or B-channel packet transmission provides reduction in wasteful line holding time for PCN. In transferring a large volume message, the use of ISDN high-speed B-channel circuit transmission is effective in reducing message transferring time for PCN. As shown in Figure 9, an economical PC communication service is provided by offering a switching facility from D-channel (or B-channel) packet transmission to B-channel circuit transmission and vice versa, according to the conversational procedure and the volume of transmission information in the message transfer procedure.

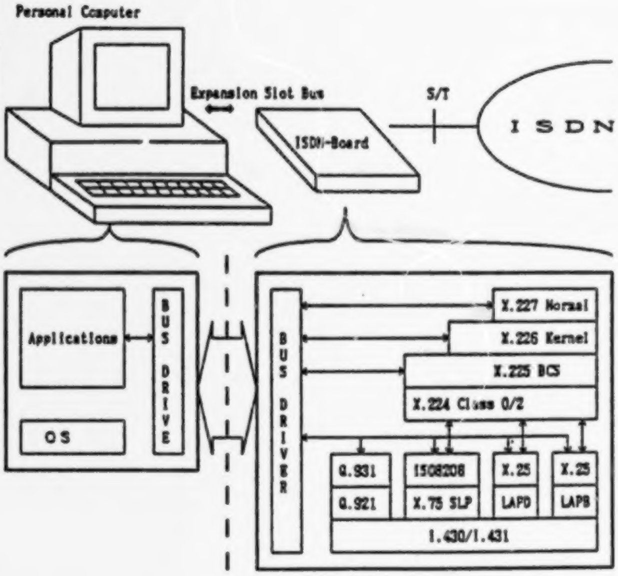

Personal Computer
Expansion Slot Bus
S/T
ISDN
ISDN-Board
Applications
OS
BUS DRIVE
BUS DRIVER
X.227 Normal
X.226 Kernel
X.225 BCS
X.224 Class 0/2
Q.931
Q.921
ISO8208
X.75 SLP
X.25
LAPD
X.25
LAPB
I.430/I.431

Figure 8 An implementation of ISDN-PC communication protocol

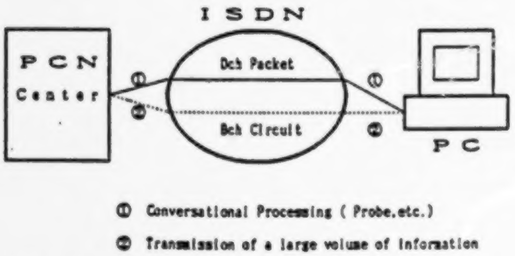

ISDN
PCN
Center
Dch Packet
Bch Circuit
①
②
①
②
PC
① Conversational Processing (Probe.etc.)
② Transmission of a large volume of information

Figure 9 An application of ISDN-PC protocol

5. CONCLUSION

This paper presented overview and some operational results of NTT-PCN. It described the necessity for PCN to interwork with ISDN, gave an outline and an implementation of a PC communication protocol over ISDN, and a PC communication service over ISDN.
The length of messages and communication durations in PCN are tending to increase. To cope with accommodation of TA-based PCs, PCNs must interwork with ISDN, which provides reduction in communication durations due to highly reliable high-speed transmission and unified interface.
MHS service is considered to be a great potential application over ISDN. PC communication protocol should be standardized based on the OSI reference model.
As an implementation of ISDN-PC communication protocol, it is proposed to implement by using a PC-board with an embedded microprocessor.
An economical PC communication service over ISDN is offered by a switching facility from D-channel (or B-channel) packet to B-channel circuit and vice versa, according to the conversational procedure and the volume of transmission information in the message transfer procedure.

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BRIEF BIOGRAPHY

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Today and Tomorrow of ISDN Services of Nippon Telegraph and Telephone Corporation

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1. ABSTRACT

In April, 1988, Nippon Telegraph and Telephone Corporation (NTT) started 'INS-Net 64 Service' providing a Basic Rate Interface as NTT's first ISDN service based on International Standards. Then, in June 1989, 'INS-Net 1500 Service' of Primary Rate Interface was also started. At present, NTT is actively preparing for commercial packet exchange services in addition to these ISDN services. This report reviews the present status and future prospects of NTT's ISDN services.

2. INTRODUCTION

As society has become more and more information-oriented, needs for telecommunications services have diversified and become high-level. That is to say, in addition to the traditional needs mainly for voice communications, needs for communication methods such as facsimile, transmission of still and moving pictures, and high-speed data transmission have been growing. To meet these diversified needs economically and efficiently, NTT started its integrated digital telecommunications service called 'INS-Net 64 Service' in April, 1988. 'INS-Net 64' was the forerunner in the world as a commercial ISDN service on a nationwide scale. It started in Tokyo, Osaka and Nagoya with 114 lines for 29 users. By the end of September of 1989, the number of service areas had grown to 77, and now there are about 2,800 lines in service for 529 users.

At the end of June, 1989, NTT started 'INS-Net 1500 Service', which can transmit information in larger quantities and higher speed than before. With the introduction of 'INS-Net 1500 Service', NTT is further expanding the features of its various services. (Figure 1)

3. THE PRESENT STATUS OF ISDN SERVICES

3.1 OUTLINE OF SERVICES

(1) INS-Net 64 SERVICE

Utilizing the existing subscriber lines of metallic cable, this service provides two information channels of 64kb/s (B channels), that can transmit voice, image, and data, and one signalling channel of 16kb/s (D channel) in a line. Thus, users can use telephone and facsimile simultaneously or use two lines at once. As many as eight terminals can be connected to one ISDN line by sharing a bus line.

(2) INS-Net 1500 SERVICE

This service requires a new optical fiber cable from the central office to the subscriber premises. This service can provide 23 or 24 information channels of 64kb/s each (B channels) or several information channels of 384kb/s (H_0 channel) by combining six B channels or one information channel of 1.5Mb/s (H_1 channel) by combining all 24 B channels.

INS-Net 1500 Service is most suitable for corporate communication systems with digital PBXs, or for picture communication systems which necessarily need a large quantity of information to transmit pictures.

3.2 SUPPLEMENTARY SERVICES IN INS-Net

(a) CALLING LINE IDENTIFICATION

The number of the calling party is displayed to the called party before communications start.

(b) SUB ADDRESSING

A particular terminal on the subscriber bus line can be called by using its sub-address.

(c) ADVICE OF CHARGE

The charge is displayed to the calling party when the communication is completed.

(d) TERMINAL PORTABILITY

The terminal can be carried from one socket to another on the same bus line without losing the call connection.

(e) FLEXIBLE PHONE SERVICE

Four functions are available: call waiting, three party service, call deflection, and call transfer. Call waiting allows a called party to answer a second incoming call while placing the first party on hold. Three party service allows the called party to dial up a third party and then it allows communication between all three parties. Call deflection allows a called party to set the terminal automatically to transfer the incoming call to another terminal. Call transfer allows the called party to dial a third party and transfer the call.

Services (a) to (d) are the basic services which need no extra contract exept for INS-Net services contract, service (e) needs extra contracts. NTT plans to add more services to INS-Net Services in the future by carefully studying user demands. (FIGURE 2)

3.3 MERITS OF INS-Net SERVICES

The special features of INS-Net Services are economy and adding value to communications. Economy of communications is achieved in two ways. First, communication speed is increased (64kb/s is much faster than the existing telephone network) and this reduces the time for communication and hence the communication charge. Second, more than one channel is available on one subscriber line, so the total number of subscribed lines will be reduced by integrating various communications services in INS-Net (in the future, users will be able to use various different telecommunications services with only an INS-Net services contract). (FIGURE 3)

Value is added to communications by implementing visual signal communications using high-speed services, such as 384kb/s and 1.5Mb/s, value added corporate communications or various new services, by utilizing the signalling channel. (FIGURE 4)

3.4 TARIFF

Tariffs for INS-Net Services are as follows.

(1) INS-Net 64 SERVICE
Subscription charge ——— ¥ 800
Installation charge ——— ¥ 72,000
Monthly access line charge
Business use ——— ¥ 5,400
Residential use ——— ¥ 4,600
Call charges
The same as ordinary analog telephone rates regardless of whether voice mode or data mode (64kb/s). (FIGURE 5, FIGURE 6)

(2) INS-Net 1500 SERVICE
Subscription charge ——— ¥ 800
Installation charge ——— ¥ 72,000
Monthly access line charge ——— ¥ 45,000
Call charges
For 64kb/s data communication, the rate is the same as the ordinary analog telephone rate.
For data communication at 384kb/s, ¥ 30 per 90 secs within local area, and for 1.5Mb/s, ¥ 60 per 50 secs within local area. (FIGURE 7, FIGURE 8)

3.5 SERVICE AREAS

At the end of September, 1989, INS-Net 64 was available in 77 areas, most of which cover the seats of prefectural offices. INS-Net 1500 has the same service areas as INS-Net 64. The number of service areas of INS-Net 64 and INS-Het 1500 will grow to about 200 by the end of 1989. As of the end of September, 1989, high-speed services, i.e., 384kb/s and 1.5Mb/s services are available in 21 areas most of which are large cities designated by government ordinances, but the areas will gradually be expanded in response to the customers' needs. (FIGURE 9)

3.6 PRESENT STATUS OF INS-Net SERVICES

(1) NUMBER OF LINES AND USERS OF INS-Net SERVICES
Number of lines and users as of the end of September, 1989:
INS-Net 64 ——— 2,723 lines (529 users)
INS-Net 1500 ——— 49 lines (14 users)
(FIGURE 10)

(2) PRESENT STATUS OF INS-Net SERVICES CLASSIFIED BY INDUSTRY

As of the end of July, 1989, the contract lines of telecommunications manufacturers and financial institutes made up over 50% of the total number of contract lines. (FIGURE 11)

4. INS-Net SERVICES APPLICATIONS

At present, the main users of INS-Net services are telecommunications manufacturers, financial institutes, and information services. Typical applications are shown below.

4.1 AUTOMATIC TELLER MACHINE MONITORING SYSTEM

Banks introduced a five-day work week in February, 1989. They are making every effort to secure a reliable and safe cash dispensing service for customers without attendance, even after business hours and when they are cloed. A security guard in a monitoring center can monitor the scene of every Cash Dispensing Service Corner by this system through INS-Net which connects the CD Corners to the monitoring center. (FIGURE 12)

4.2 DATA TRANSMISSION SYSTEM

This system enables high-speed (64kb/s) and high-quality transmission of sales data and customer data to the central computer and enables data processing in the center. This system increases reliability and reduces communications costs compared with ordinary telephone lines (4800b/s).

4.3 COLOR OR TEXT PROOFREADING SYSTEM

Color pictures or illustrations for printing catalogues, pamphlets or magazines stored in a data base can be retrieved at any time when they are needed. This system can speed up the proofreading work of printing by using high resolution color displays through INS-Net line connection. Conventional proofreading entails a lot of physical running back and forth between the headquarters and the factory of printing company and the customer. (FIGURE 13)

4.4 DATABASE ACCESS SYSTEM

A huge quantity of articles are published in newspapers and magazines everyday. This system stores those articles in a computer memory and can deliver necessary information to the contracted users very fast by clipping the information out of the articles. This system employ INS-Net 64 and G4 facsimile, so it can send very clearly articles containing very small letters or photographs and drawings. (FIGURE 14)

4.5 VIDEO CONFERENCING SYSTEM

Existing video conferencing systems require a leased circuit between every two points. Making use of the public switched digital lines provided by INS-Net, a multi-location video conferencing system can be established easily and at lower cost. (FIGURE 15)

4.6 INTRA-COMPANY INTEGRATED COMMUNICATIONS STRUCTURE

This system is well suited for point to multipoint (1:n) corporate communiation, which has insufficient traffic to justify the use of a leased circuit. This system is also useful as a backup use or to handle peak loads on a corporate communication network. (FIGURE 16)

5. INTERNATIONAL ISDN SERVICE

5.1 OUTLINE OF THE SERVICE

NTT's INS-Net services was connected to KDD's international ISDN services in October, 1989. Users of INS-Net services can now have an international telepone service. If users of INS-Net services contract directly with KDD, they can also use 64kb/s international digital circuit-switched service, international public data transmission service (VENUS-P), international mailbox service (Messavia), and international facsimile communication service (F-PORT).

5.2 SERVICE AREA

International ISDN service is available between the U.S., the U.K., and Japan. INS-Net services are connected with ISDN services of Primary Rate Interface and Accunet Switched service which AT&T offers in the U.S.,and IDA (Integrated Digital Access) service which BT offers in the U.K., via KDD's international ISDN services.

6. FUTURE PROSPECTS

The commencement of INS-Net 1500 Service accelerated the use of digital communiations, mainly by corporations. Standadization of the main equipment of ISDN, such as G4 facsimile and terminal adapter, is now complete. Application development and development of telecommunication equipment reflecting the opinions of users will accelerate in the future. It will be very important to study how to develop and how to apply INS-Net services in communications among corporations in different sectors or in different countries, reflecting the trend of rapidly developing society. NTT will make every effort to expand the service area of INS-Net services and also to improve the quality of the services.

NTT's ISDN implementation schedule

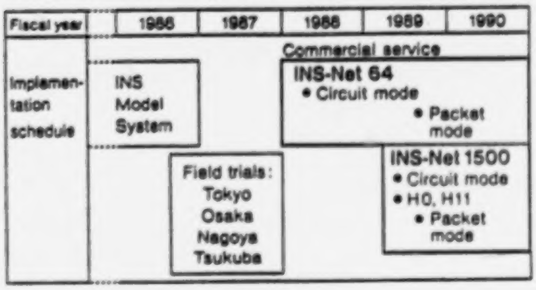


FIGURE 1

Supplementary Services

- Calling line identification
- Sub addressing
- Advice of charge

(from Apr. 1988)

- Terminal portability
- Call waiting
- Three party service
- Call deflection
- Call transfer

(from Aug. 1989)

FIGURE 2

Cost efficient integrated network

Cost reduction in direct telecom expenditure
- Elimination of redundant circuits
- Hi-speed transmission
- Usage sensitive rate structure
- Flexible multi-point network configuration

Intra/Inter company network applications

FIGURE 3

Enhanced services network

Improvements in business systems
- Visual (image/video) communications
- Hi-speed data transfer
- Signaling channel applications

FIGURE 4

Tariff of INS-Net 64 services

	INS-Net 64 (circuit-switched)
Subscription charge	¥800
Monthly Access line charges	● Business-use ¥5,400 ● Residential-use ¥4,600
Call charges	Same as ordinary analog telephone rates

FIGURE 5 NTT ⓞ

Rate for 64Kb/s Digital Communications mode

Call Category	64Kb/s seconds per ¥10	Call Category	64Kb/s seconds per ¥10
Local	180	Up to 80 km	15.5
Adjacent Area	90	Up to 100 km	13.5
Up to 20 km	90	Up to 120 km	10.5
Up to 30 km	38	Up to 160 km	10.5
Up to 40 km	30	Up to 200 km	7
Up to 60 km	21	Up to 300 km	7
		More than 300 km	5.5

FIGURE 6 NTT ⓞ

Tariff of INS-Net 1500

		INS-Net 1500 (circuit-switched)
Subscription charge		¥800
Monthly access line charges		¥45,000
Call charges	Telephone communications mode	Same as ordinary analog telephone rates
	64Kb/s digital communications mode	
	384Kb/s, 1.5Mb/s digital communications mode	See next slide
High-speed digital communications mode surcharge		¥2,000

FIGURE 7 NTT ⓞ

Usage charges for high-speed digital communications mode

Call Category	384kb/s (seconds per ¥30)	1.5Mb/s (seconds per ¥60)
Local	90	50
Adjacent area	45	25
Up to 30 km	45	25
More than 30 up to 60 km	15	9
More than 60 up to 100 km	8	7
More than 100 up to 160 km	7	6
More than 160 up to 320 km	6.5	5
More than 320 km	6	4.5

FIGURE 8 NTT ⓞ

INS-Net service area

(Sep 1989)

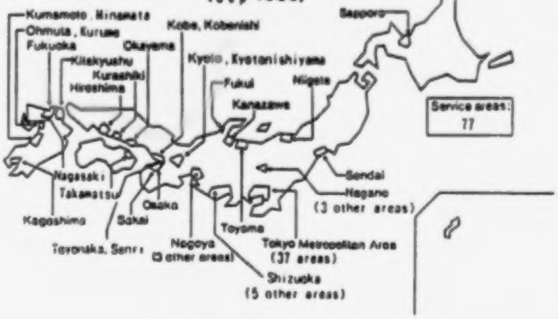

Kumamoto, Minamata
Ohmuta, Kurume
Fukuoka
Kitakyushu
Kurashiki
Hiroshima
Okayama
Kobe, Kobenishi
Kyoto, Kyotanishiyama
Fukui
Niigata
Sapporo
Kanazawa
Service areas: 77
Nagasaki
Takamatsu
Kagoshima
Sakai
Osaka
Toyonaka, Senri
Nagoya (3 other areas)
Toyama
Tokyo Metropolitan Area (37 areas)
Shizuoka (5 other areas)
Sendai
Nagano (3 other areas)

FIGURE 9 NTT ⓞ

SCALE OF INS-Net

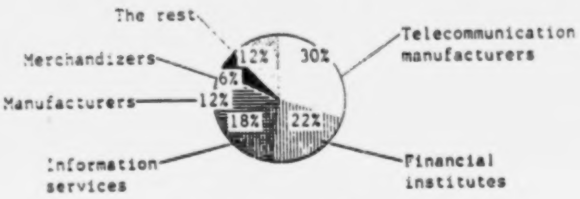
(AS OF SEPTEMBER 1989)

	BRI	PRI
Area	77	77*
Number of customers	529	14
Number of subscriber lines	2723	49

*Hi-speed communication mode is available in 21 cities.

FIGURE 10 NTT ⓞ

Present status of INS-Net services classified by industry



As of the end of July, 1989

FIGURE 11

NTT ©

Automatic teller machine monitoring system

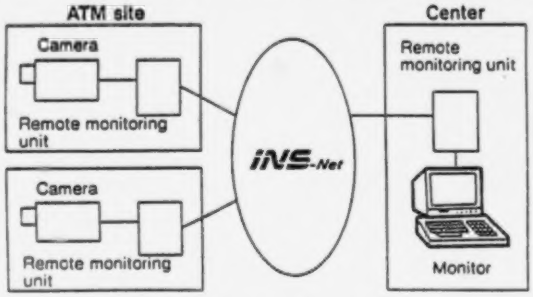

ATM site
Camera
Remote monitoring unit
Camera
Remote monitoring unit
INS-Net
Center
Remote monitoring unit
Monitor

FIGURE 12

NTT ©

Color or text proofreading system

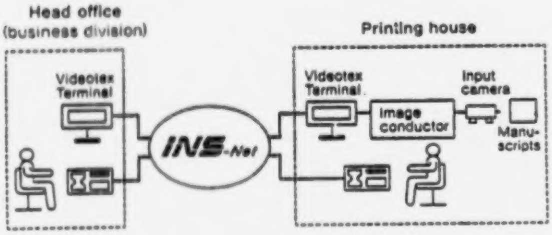

Head office (business division)
Videotex Terminal
INS-Net
Printing house
Videotex Terminal
Image conductor
Input camera
Manu-scripts

FIGURE 13

NTT ©

Database access system

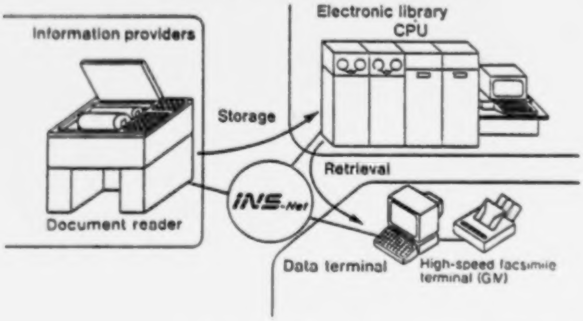

Information providers
Document reader
Storage
Electronic library CPU
Retrieval
INS-Net
Data terminal
High-speed facsimile terminal (G4)

FIGURE 14

NTT ©

Video conferencing system

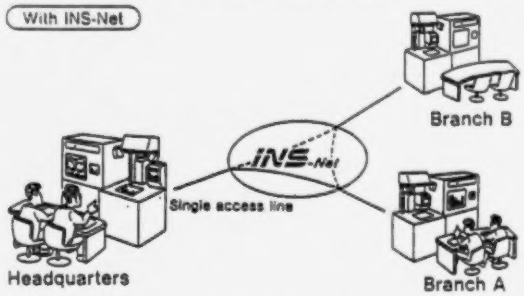

With INS-Net
Branch B
INS-Net
Single access line
Headquarters
Branch A

FIGURE 15

NTT ©

Intra-company integrated communications structure

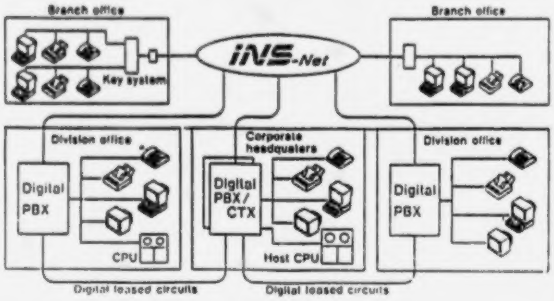

Branch office
Key system
INS-Net
Branch office
Division office
Digital PBX
CPU
Corporate headquaters
Digital PBX / CTX
Host CPU
Division office
Digital PBX
Digital leased circuits
Digital leased circuits

FIGURE 16

NTT ©

Session 4.3

Mobile Communication Update

NOTES

Data Transmission Within Buildings for Portable Communication at 60GHz

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1. ABSTRACT

The work described in this paper is concerned with the transmission of data for portable communication within buildings using 60GHz phase locked sources and frequency shift keying (FSK) as a method of modulation. The bit error rate (BER) measurements were conducted within buildings under fading and non-fading conditions. The method of measurements were designed to simulate the type of usage expected from the integrated portable communication systems operating at 60 GHz.

2. INTRODUCTION

The popularity of the cordless telephone and cellular mobile radio clearly demonstrate the demand for cordless portable communications. Therefore, in future, due to the increase in demand for portable and mobile communications, several spectrum congestion will occur again within the allocated frequency bands below 1 GHz. For example, in cellular mobile radio systems, effort has being now concentrated toward optimising the efficient use of the available frequency spectrum through efficient modulation techniques and systems. However, if this being acheived by the end of centuary, severe spectrum congestion will occur again within the allocated frequency bands no matter what ever modulation is used. The existing frequency allocations and the available bandwidth will be unable to fulfill the increase in the number of users and to accommodate wide-band modulation techniques. Therefore, the only solution to the spectrum congestion is to exploit higher frequency bands above 1 GHz wherever available which could provide large amounts of bandwidth. Furthermore, there is considerable interest in establishing in future, local cellular radio network (LCRNs) which could provide a broad range of wideband services in both urban and suburban areas (1).

A region of the radio spectrum is being sought which could accommodate large number of users and wideband modulation techniques especially in the usual hot spots where most of the people spend their time such as shopping concorse, city centres, public transport termini, office blocks, factories and major road and motoway intersections. However, the interest is in the millimetric wave-band around 60 GHz which posses the path attenuation of about 16 dB/km at sea level due to the oxygen absorptions. The aim is to propose a system which will provides an integrated portable communications and a wide range of digital services to the user both within buildings and outdoors.

The modulation system used at 60GHz must be capable of transmitting high bit rate digital signals, so it can be assumed that a digital modulation method will be used. An analogue signal such as speech can be digitised to convert it to a digital signal. One practical way of estimating the ability of transmitting data through a 60GHz radio link is by performing bit error rate (BER) measurements under fading conditions.

The work described here is concerned with the bit error rate (BER) measurements conducted within buildings using FSK through 60 GHz radio link with fading and non-fading conditions. The method of measurements were designed to simulate the type of usage expected from the integrated portable communication systems operating at 60 GHz.

2. DESCRIPTION OF THE FSK MODEM.

Figure 1 shows the block diagram of the FSK modem. One method of producing FSK is by feeding the digital baseband data to an FM modulator. This is known as direct binary FSK. It can be generated by using circuits which switch the frequency of an oscillator (2). One of these methods makes use of a free running oscillator whose frequency is controlled by a voltage. This is called a voltage controlled oscillator (VCO).

The data was generated by using a 7 bit shift register and an exclusive-or gate to produce a 127 bit length pseudo random binary sequence (PRBS). Transmission rates of 240 and 480kbit/sec were used. The FSK encoder had a centre frequency of 60MHz, and was realised by feeding the PRBS to a 60MHz VCO. The ratio of peak frequency deviation to bit rate used was 0.5. Figure 2 shows the output spectrum of the FSK modulator at 240 and 480kbits/sec.

The demodulator consists of a 60MHz bandpass filter, a limiter, a frequency discriminator, an integrate and dump filter, and a decision circuit. The bandpass filter removes components of noise outside the signal band in addition to shaping the received signal. It was a second order Bessel filter, whose noise bandwidth was 373kHz for the 240kbits/sec and 752kHz for the 480kbits/sec measurements. The limiter and frequency discriminator produce an output voltage level proportional to the input frequency, and when receiving an FSK signal, the output alternates between the two logic voltage levels. The characteristics of the discriminator must be linear so that the output voltage response is proportional to the input frequency. Because the amplitude of the received FSK signal varies due to fading, a pre-detection amplitude limiter is used. Integrate and dump circuitry and decision circuitry were used to convert the two noisy logic levels into a reconstituted data signal.

3. CHARACTERISING THE FSK MODEM

The FSK modem needs to be characterised by measuring the BER performance in white Gaussian noise (WGN) before it can be used with the 60GHz system. This is to ensure that the performance of the system is optimum.

In order to determine the signal to noise ratio (SNR), the band limited signal and noise power were measured separately at the bandpass filter output by using a power meter. If the noise power is P_n and the signal power is P_s, then the normalised SNR is found from

$$SNR_{norm} = \frac{P_s}{P_n} \cdot \frac{B_n}{f_s}$$

where B_n is the noise bandwidth of the bandpass filter and f_s is the data rate in bits/sec.

The demodulated data at point Y in fig. 3 was then compared with the transmitted data at point X on a bit-by-bit basis. The error detector circuit used an exclusive-or gate and the output of this was sampled with the sampling pulse stream derived from the clock generator. An error pulse is obtained at the output of the error detector at the sampling pulses whenever the transmitted and demodulated data differ.

The error pulses were counted on a frequency meter over a 10sec period for a certain value of SNR. The error counting measurements were repeated for different SNR's. The ratio of the number of errors counted per second to the number of bits transmitted per second in the 10 second period gives the BER for the modem. Hence, if the reading of the frequency meter is f_e for a transmitted data rate f_s, then the BER is given by

$$BER = \frac{f_e}{f_s}$$

The curve for the measured BER versus SNR in WGN was plotted as shown in figure 4 together with the theoretical curve (3,4). The results show that the FSK modem falls within 1dB of the theoretical performance expected for FSK with discriminator detection.

4. TRANSMISSION OF FSK SIGNAL THROUGH THE 60GHz RADIO LINK

The BER measurements were made with the experimental system shown in figure 5. The output of the FSK generator was up-converted to 60GHz by an Alpha 964V01E modulator. The output of the modulator consisted principally of 2 sidebands at 59.96GHz and 59.84GHz (60MHz above and below the 59.9GHz output from the phase-locked oscillator). Because it was too difficult to design a filter at 60GHz, both sidebands were transmitted. The loss of the modulator was 10dB which is the modulator input power at 59.9GHz in dBm minus the output power of the wanted 59.96GHz sideband in dBm. The transmitted power was therefore 10dB below the 50mW output power of the transmitter, which is 5mW. At the receiver, the 58.9GHz phase-locked local oscillator down-converted the transmitted sidebands to 1.06GHz and 0.94GHz. The bandpass filter passed only the 1.06GHz sideband, which was further down-converted to 60MHz by using a mixer and a 1GHz local oscillator.

The phase-locked oscillators with frequency stabilities of +/- 1 in 10^8 over the temperature range 0 to 50^0C when phase-locked to external 100MHz crystal oscillators. The aerials used for the measurements were the omnidirectional aerials which had gains of about 7dB, beamwidths of about 20^0 and were circularly polarised.

5. EXPERIMENTAL PROCEDURE AND RESULTS.

The procedure described above was used to obtain the BER for different SNR's. For these measurements, instead of adding the WGN, the signal was transmitted through the 60GHz radio link.

The first measurements were conducted when there was a LOS path between the stationary transmitter and receiver. The second measurements were conducted by randomly moving the transmitter in a horizontal plane in order to produce fading, and the received signal envelope was recorded on the FM tape recorder. The received signal envelope during the fading period was computed in order to obtain the mean received signal power and the envelope distribution. It was later calibrated to give the mean normalised SNR for that particular level. The procedure was repeated for different power levels and therefore SNR's.

The third measurements were conducted when there was no LOS path between the transmitter and receiver. The transmitter was placed behind a metal cabinet, so that the signal was received through reflections from surrounding objects and diffraction around the metal cabinet. The received signal envelope was recorded on the FM tape recorder and was later analysed in order to determine the mean signal power and the envelope fading statistics.

When there was a LOS path between the transmitter and receiver, the envelope distribution departed from the Rayleigh distribution. However, for non-LOS conditions, where the signal was received through reflections from and diffractions around the surroundings, a near Rayleigh distribution was obtained.

The BER was plotted against the mean normalised SNR for both LOS and non-LOS conditions together with the theoretical curve derived earlier for non-coherent FSK in Rayleigh fading as the dotted line shown in figure 6. For comparison, the theoretical non-coherent FSK curve of the BER with no fading was plotted as the full line on the same graph.

It is interesting to note from the figure that, for non-LOS conditions, where the envelope was found to obey the Rayleigh distribution, the experimental curves for the BER are a close fit to the theoretical curves for Rayleigh fading. The BER performance was worse for Rayleigh fading when there was no LOS path compared to the non-Rayleigh fading when there was a LOS path. For Rayleigh fading, in order to maintain a BER of 1 in 10^3, an increase of about 18dB in mean SNR was required compared to when there is no fading. However, when there was a LOS path between the transmitter and receiver, a BER of 1 in 10^3 required an increase of about 13dB in average SNR compared to that in the absence of fading.

The results also indicate that for the conditions of the experiments conducted, no irreducible error rate under LOS or non-LOS conditions occurred. This implies that the time delay spread was much less than the bit duration of the transmitted data so it experienced negligible intersymbol interference. This is because the path lengths in the room were short and there were presumably not many strong multiple reflections. The lack of an irreducible error rate also implies that the random FM due to doppler shifts was much smaller than the FM of the FSK signal. This is because the mobile transmitter was moved at a slow speed. In other areas, particularly outdoors, much higher doppler shifts and much higher time delay spreads could be experienced, so under these conditions, an irreducible error rate would perhaps have occurred.

6. METHODS OF IMPROVING THE BER PERFORMANCE

The results show that a high SNR is required to obtain a reasonable BER when Rayleigh fading is present. Since Rayleigh fading occurs under non-LOS conditions when the SNR is at its lowest, the BER may be too high for a working system that has to cover an entire room with only one radio distribution port. The bit rates used were 240kbit/sec and 480kbit/sec which are relatively low. If, however, a higher bit rate is used, the BER would be higher because of the wider bandwidth which results in a higher noise power and therefore a worse SNR. In addition, in some locations, particularly outdoors where path lengths are usually longer, the time delay spread may be much greater, so higher bit rates may result in a very high irreducible error rate due to intersymbol interference. It is therefore desirable to find methods to significantly improve it. The BER could be improved by increasing the transmitted power. For example, by using a non-phase-locked transmitter, the loss in the modulator could be eliminated because the 60GHz oscillator could be frequency modulated directly, so that no modulator is needed. This would increase the transmitted power by 10dB in this case, and would also make transceivers less costly and complex. Diversity reception is another possibility which would greatly reduce the BER. It also can be used in conjunction with coding techniques which may provide a good solution to the problem.

Another possibility is to use DPSK instead of FSK, because it gives better performance in slow non-selective Rayleigh fading. However, a modulator is needed for the transmitter which has a typical loss of about 4 dB. If it is also used outdoors, they may be problems due to high vehicle speeds. These would produce a worse irreducible error rate than they would in FSK.

7. CONCLUSION

Since no irreducible error rate occurred in the BER measuremants at 480kbit/sec, it is possible that a higher bit rate could be used without problems of intersymbol interference caused by time delay spread. However, in other areas, the time delay spread may be higher, a lower bit rate would have to be used.

8. REFERENCES

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(5) Jakes, W.," Mobile Microwave Communication," McGraw-Hill, 1974.

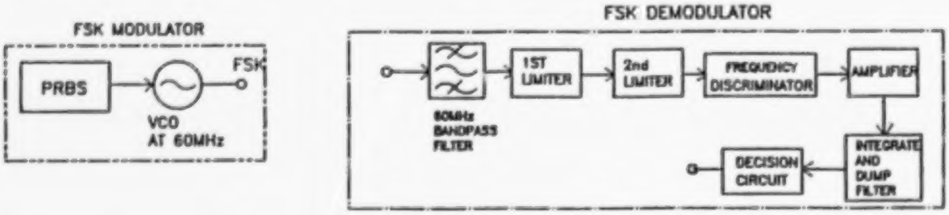
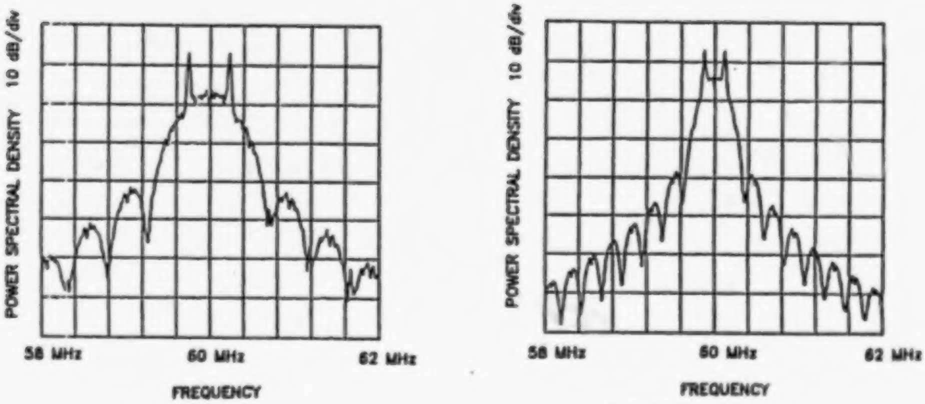


Figure 1 BLOCK DIAGRAM OF FSK MODEM USED FOR THE BER MEASUREMENTS.



DATA RATE = 480 kbit/sec

DATA RATE = 240 kbit/sec

Figure 2 OUTPUT SPECTRUM OF THE 60MHz FSK MODULATOR

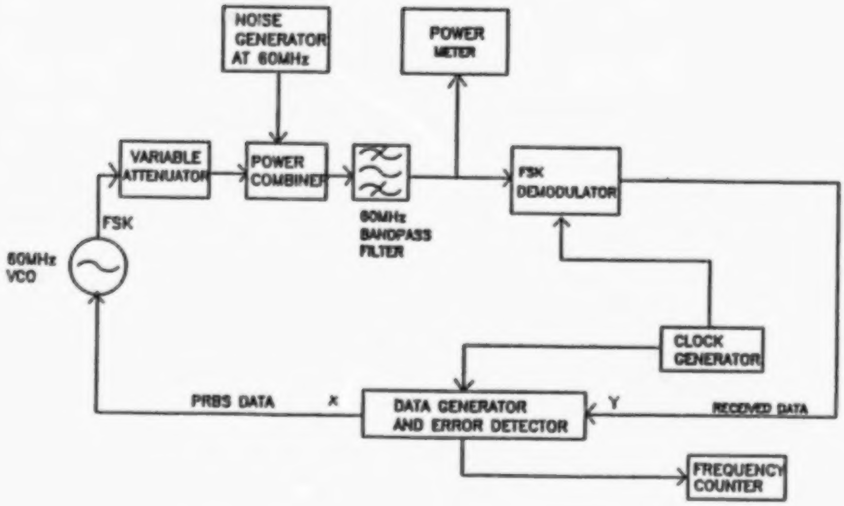

NOISE GENERATOR AT 60MHz
POWER METER
VARIABLE ATTENUATOR
POWER COMBINER
60MHz BANDPASS FILTER
FSK DEMODULATOR
FSK
60MHz VCO
CLOCK GENERATOR
PRBS DATA
X
DATA GENERATOR AND ERROR DETECTOR
Y
RECEIVED DATA
FREQUENCY COUNTER

Figure 3 EQUIPMENT FOR BER MEASUREMENTS IN WGN FOR FSK MODEM.

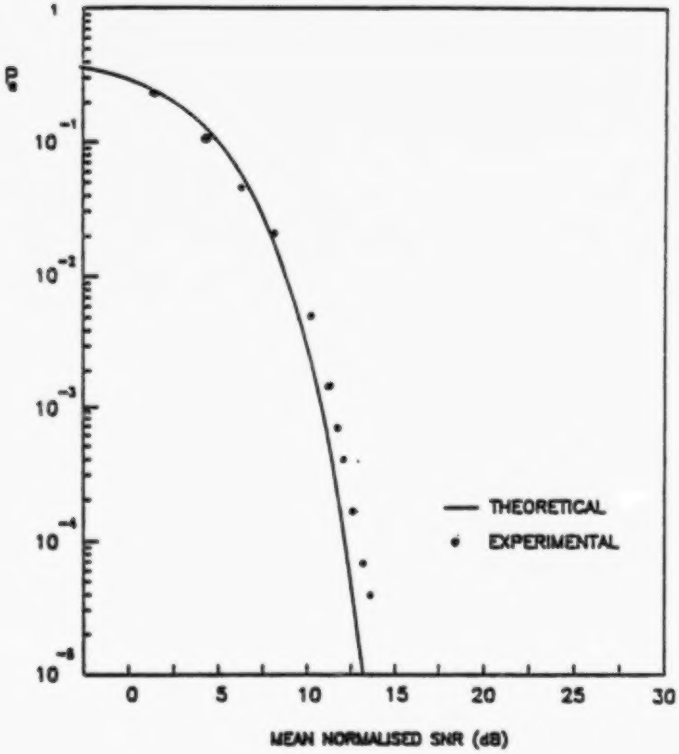


Figure 4 BER FOR NON-COHERENT FSK IN WGN

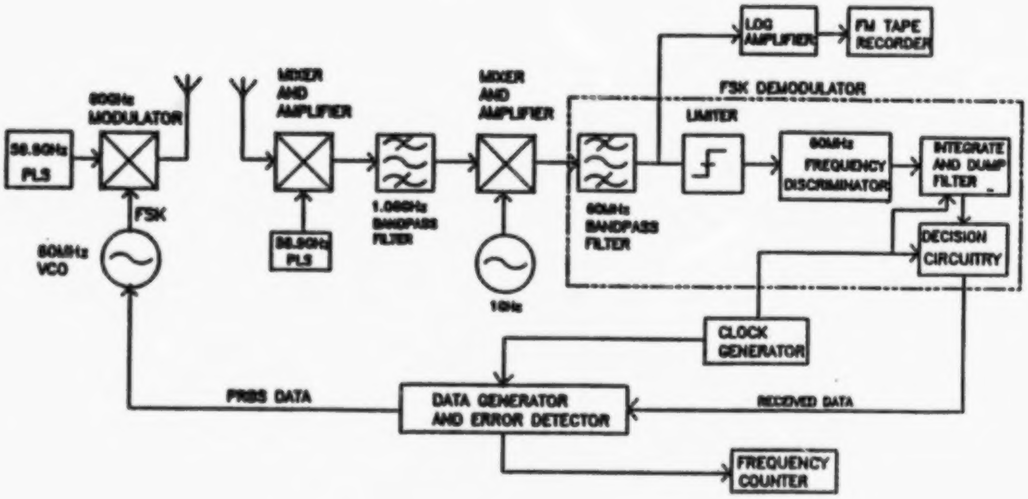

58.9GHz PLS
60GHz MODULATOR
FSK
60MHz VCO
MIXER AND AMPLIFIER
58.9GHz PLS
1.06GHz BANDPASS FILTER
MIXER AND AMPLIFIER
1GHz
FSK DEMODULATOR
60MHz BANDPASS FILTER
LOG AMPLIFIER
FM TAPE RECORDER
LIMITER
60MHz FREQUENCY DISCRIMINATOR
INTEGRATE AND DUMP FILTER
DECISION CIRCUITRY
CLOCK GENERATOR
PRBS DATA
DATA GENERATOR AND ERROR DETECTOR
RECEIVED DATA
FREQUENCY COUNTER

Figure 5 BIT ERROR RATE MEASUREMENT EQUIPMENT

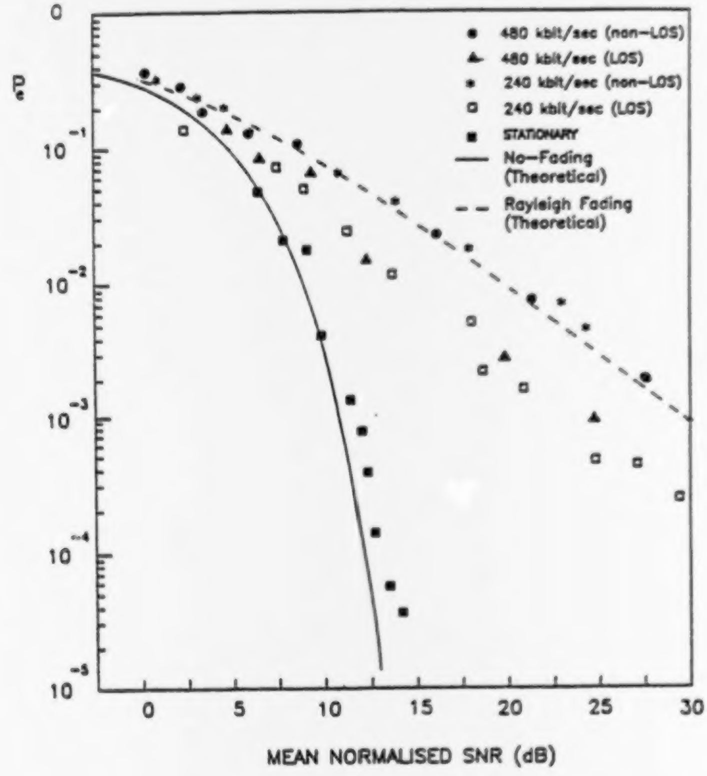


Figure 6 BER IN FADING AND NON-FADING CONDITIONS FOR NON-COHERENT FSK.

Development of Aeronautical Satellite Communications

Hiroyuki Nakamura, Nobuyuki Kawai

Satellite Communication Engineering Division
Satellite & Radio Communication Department
Transmission System Engineering Headquarters
Kokusai Denshin Denwa Co., Ltd. (KDD), Japan

1. Abstract

KDD plans to introduce aeronautical satellite communication services consisting of telephone and data transmissions following a series of field trial programs.

In this paper, the overview of KDD's plan for aeronautical services is discussed.

2. Introduction

In the field of aeronautical telecommunications, VHF and HF-band radio frequency has been used for control and passenger communications, however which are limited by the constraint of their coverage and quality. Recently, developments of aeronautical satellite communication systems are under way on world-wide basis, which have major characteristics such as wide coverage, high quality and flexibility for various service applications.

The aeronautical satellite communication systems consist of a space segment, an aircraft earth station (AES), a ground earth station (GES) and the ground network. The service applications include voice and data communications.

At the INMARSAT 4th Assembly in 1985, the Convention and Operating Agreement were amended, enabling the Organization to provide aeronautical satellite communication services to the aeronautical community, followed by working for ratification. As a result, the amended Convention entered into force in October 1989. INMARSAT is also working for revision of SDM (System Definition Manual) which describes specifications of aeronautical system in detail.

The ICAO Council Special Committee on Future Air Navigation Systems (FANS) was established and defined a minimum core capability of aeronautical mobile satellite service, and outline a growth path for a future high capacity system. Based on the result of FANS's discussion, Aeronautical Mobile-Satellite Service Panel (AMSSP) has been formed to develop the technical specifications (SARPs: Standard and Recommended Practices) and guidance material.

AEEC (Airlines Electronic Engineering Committee) has been specifying ARINC 741 which is related with specifications of SATCOM airborne equipment such as antenna subsystem, RF subsystem and satellite data subsystem.

Taking account of these situations, KDD has been conducting a series of field trials consisting of Phase-I and Phase-II, and also plans to introduce aeronautical satellite communication services providing data and telephone services, utilizing outcome of technical development in field trials. The whole schedule of KDD's trials and services is summarized as follows:

87/Oct. - 88/Mar.	Phase I trials
90/Apr.	*POR Data (Interim)
90/July - 90/Sept.	Phase II trials
90/Dec.	*POR Telephone *IOR Data (Interim)
92 or 93	*IOR/POR Full-scale service (Data/Tel)

* commercial service

3. Field trials

3.1 Phase-I

3.1.1 General

Tests of Phase-I program was conducted from October 1987 to March 1988 in cooperation with the Ministry of Posts and Telecommunications (MPT) and JAL. In phase-I trials, INMARSAT satellite (MCS-D: Pacific Ocean Region) as the space segment, Boeing 747 of Japan Air Line (JAL) as the AES and KDD Ibaraki Coast Earth Station as the GES were used. Main objectives of trials were to acquire basic data in terms of propagation and circuit quality and to assess the feasibility of voice/data.

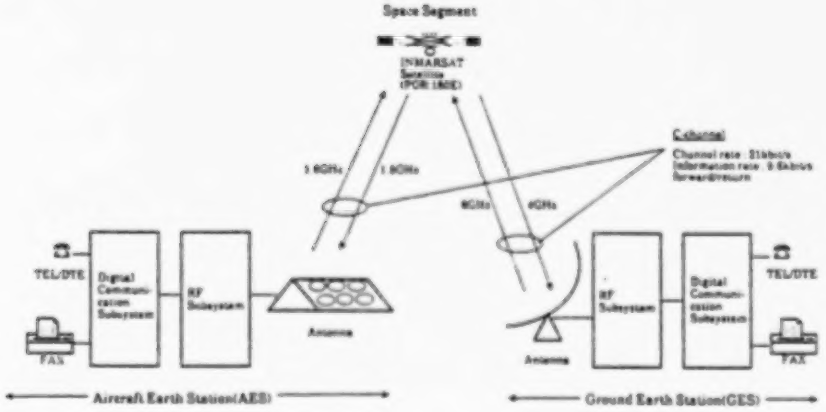

Space Segment
INMARSAT Satellite (POR:180E)
C-channel
Channel rate : 21kbit/s
Information rate : 9.6kbit/s
forward/return
1.6GHz
1.5GHz
6GHz
4GHz
TEL/DTE
Digital Communication Subsystem
RF Subsystem
Antenna
FAX
Antenna
RF Subsystem
Digital Communication Subsystem
TEL/DTE
FAX
Aircraft Earth Station(AES)
Ground Earth Station(GES)

Figure 1 Overall Experimental System Configuration of Phase I

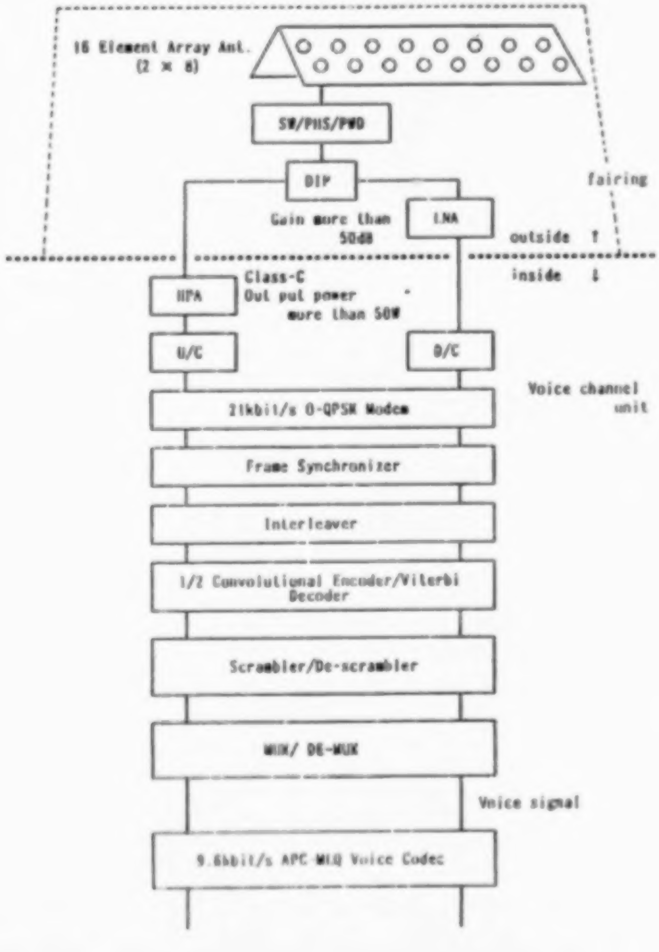

16 Element Array Ant.
(2 × 8)
SW/PHS/PWD
DIP
fairing
Gain more than
50dB
LNA
outside ↑
inside ↓
HPA
Class-C
Out put power
more than 50W
U/C
D/C
Voice channel
unit
21kbit/s O-QPSK Modem
Frame Synchronizer
Interleaver
1/2 Convolutional Encoder/Viterbi
Decoder
Scrambler/De-scrambler
MUX/ DE-MUX
Voice signal
9.6kbit/s APC MLQ Voice Codec

Figure 2

Functional Block Diagram of Antenna/RF Subsystem (Phase I)

3.1.2 System configuration

Overall experimental system is shown in Figure 1. Experimental equipment, of both the GES and AES, is composed of a digital communication subsystem and an antenna/RF subsystem. Functional block diagram of the AES is shown in Figure 2. Figure 3 (photographs) shows appearances of AES antenna and cabin equipment.

Communications are provided through only C-channel (communication channel). Both direction (forward/return) of C-channel consists of both direction (forward/return) of 21kbit/s digital communication link including 9.6kbit/s voice channel and 300bit/s signalling channel. As for the modulation method, O-QPSK is employed. Table 1 shows major parameters of C-channel. Link parameters are designed to obtain the channel BER of 10^{-3}.

Antenna for AES designed by Radio Research Laboratory (RRL) of MPT is phased array type with 2x8 radiation units at each side of the low dorsal fin mounted on the fuselage. For the RF subsystem, class-C high-power amplifier (HPA) and low noise amplifier (LNA) are employed. Table 2 shows major parameters of AES antenna/RF subsystem.

For the GES equipment, the digital communication subsystem is connected through the IF port with the antenna/RF subsystem of Ibaraki Coast Earth Station being used for the INMARSAT maritime satellite communication service.

Experimental circuit for demonstration is set up between AES and GES, and then extended to PSTN by manual.

3.1.3 Test item

Major test items are shown below:

1) Measurement of L-band wave propagation characteristics as a function of elevation angle and sea-surface condition
2) Evaluation of carrier/clock recovery and frame synchronization performance
3) Measurement of bit error rate (BER) performance with and without FEC
4) Conversational test of the 9.6kbit/s APC-MLQ voice coding
5) Demonstration of overall system performance

Signal mode	SCPC(continuous mode)
Carrier spacing	17.5kHz
Transmission bit rate	21kbit/s
Information bit rate	9.6kbit/s(voice) / 600bit/s(data)
Modulation	Offset QPSK
TX/RX filters	Square root raised-cosine Nyquist filter with 60% roll-off for O-QPSK
FEC	Rate 1/2 coding (K=7) / 8-level soft decision Viterbi decoding
Voice coding	APC-MLQ (Adaptive Predictive Coding with Maximum Likelihood Quantization
Bit interleaving	block size : 64 x 6bits (delay : 18msec for each end)

Table 1 Major Parameters of C-channel (Phase I)

Antenna type	2 x 8(16) element phased array antenna
G/T	-13dBk(+/- 45degrees)
Antenna gain	13.5dBi (TX) 14.7dBi (RX)
Steering range	+/- 60 degrees in Azimuth steerable 4 degrees each fixed pattern in Elevation
Tracking	Program tracking using the INS signal
Size	180 H x 760 W x 320 D mm
Weight	18 kg
HPA	Class-C HPA / max 50 W
LNA	GaAs FET (Noise Temp.= 90 K)

Table 2 Major parameters of AES antenna/RF subsystem (Phase I)

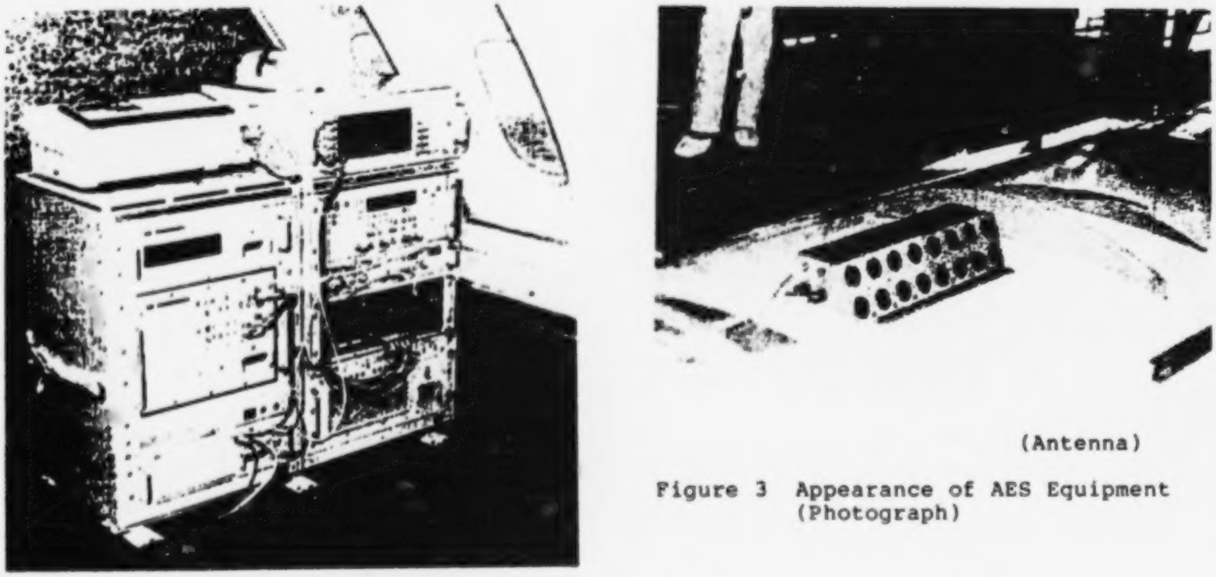
3.1.4 Flight routes

Several flight tests and demonstrations have been conducted since October 1987.

Flight routes comprise
Tokyo-Anchorage (4 times),
Tokyo-Vancouver (4 times),
Tokyo-Los Angeles (3 times),
Tokyo-Seattle (2 times) and
Tokyo-Honolulu (1 time)

3.1.5 Test results

Test results are summarized as follows:



(Cabin Equipment)

(Antenna)

Figure 3 Appearance of AES Equipment (Photograph)

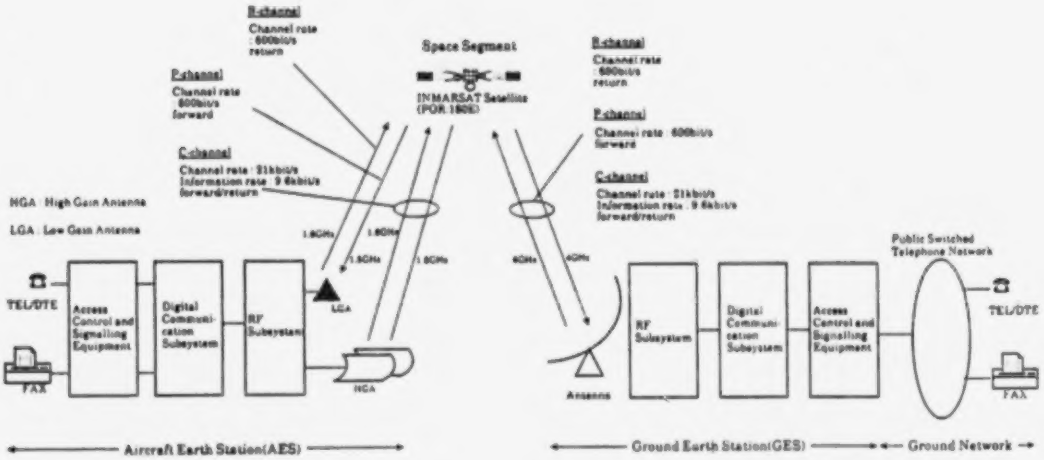

R-channel
Channel rate : 600bit/s return
P-channel
Channel rate : 600bit/s forward
C-channel
Channel rate : 21kbit/s
Information rate : 9.6kbit/s
forward/return
Space Segment
INMARSAT Satellite (POR 180E)
HGA : High Gain Antenna
LGA : Low Gain Antenna
1.6GHz
1.6GHz
1.5GHz
1.5GHz
TEL/DTE
FAX
Access Control and Signalling Equipment
Digital Communication Subsystem
RF Subsystem
LGA
HGA
Aircraft Earth Station(AES)
R-channel
Channel rate : 600bit/s return
P-channel
Channel rate : 600bit/s forward
C-channel
Channel rate : 21kbit/s
Information rate : 9.6kbit/s
forward/return
6GHz
4GHz
Antenna
RF Subsystem
Digital Communication Subsystem
Access Control and Signalling Equipment
Public Switched Telephone Network
TEL/DTE
FAX
Ground Earth Station(GES)
Ground Network

Figure 4 Overall Experimental System Configuration of Phase II

1) The INMARSAT voice transmission parameters such as eirp's of satellite, AES and GES, the required C/No, etc. have been verified acceptable at the AES elevation angle above 15 degrees.
2) The conversational test shows that 9.6kbit/s voice coding system can provide a high voice quality for the aeronautical satellite communication services.
3) The demodulator synchronization loss was observed due to the phase jump caused by antenna beam switching. The development of the tracking subsystem for AES antenna is required to maintain the continuity of the signal phase.
4) Multipath fading caused by the reflection on the sea surface and on the aircraft was observed. The antenna location on the aeroplane should be selected so as to avoid the reflection on the aircraft surface.

3.2 Phase-II

3.2.1 General

KDD plans to conduct phase-II program from second quarter of 1990 for 3 month in cooperation with Japan Air Lines.

Main objectives of phase-II program are to verify the access control and signalling function specified by INMARSAT and to introduce commercial services smoothly.

3.2.2 System configuration

Figure 4 shows overall experimental system configuration of phase-II.

The experimental equipment, of both AES and GES, includes Access Control and Signalling Equipment (ACSE) in addition to digital communication subsystem and antenna/RF subsystem.

Communication links between AES and GES consist of P-channel (Packet mode TDM channel: forward) and R-channel (Random access channel: return) in addition to C-channel used in Phase-I. Characteristics of channels are shown in Table 3. P/R channel is used for transmission of signalling and user data, and C-channel is used for transmission of voice and circuit-mode data (including FAX).

Channel name	C-channel	P-cnannel	R-channel
Signal mode	SCPC *1	Continuous (Packet mode TDM)	Burst mode (Random access)
Carrier spacing	17.5kHz	5.0kHz	2.5kHz
Transmission bit rate	21kbit/s	600bit/s	600bit/s
Information rate	9.6kbit/s(voice) 600bit/s(data)	288bit/s (signalling)	152bit/s (signalling)
Modulation	Offset-QPSK	Aviation-BPSK *2	Aviation-BPSK *2
TX/RX filters	Square root 100% raised cosine	Square root 40% raised cosine	Square root 40% raised cosine
FEC	rate 1/2 coding 8-level soft decision Viterbi decoding	rate 1/2 coding 8-level soft decision Viterbi decoding	rate 1/2 coding 8-level soft decision Viterbi decoding
Voice coding	LPC(Linear Predictive Coding)	–	–
Bit interleaving (Block Size)	64 × 6 bits	64 × 6 bits	64 × 5 bits

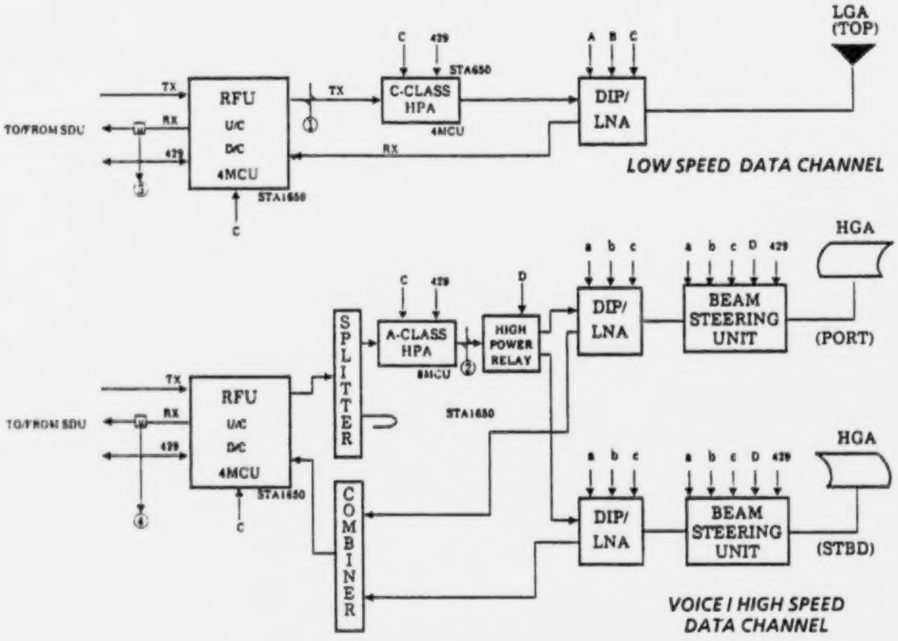
*1 Continuous mode(return)/Burst mode for voice activation(forward)
*2 A form of differential encoded BPSK

Table 3 Characteristics of channels used in Phase II

Item	High Gain system	Low Gain system
Antenna type	5 x 4(20) element conformal phased array antenna (side-mount)	Helical antenna (top-mount)
G/T	-13dBk	-26dBk
Antenna gain	12dBic	0dBic
Steering range	+/- 60 degrees in both Azimuth and Elevation from the center	Non-Steering (coverage: greater than 5 degrees in Elevation)
Tracking	Program tracking using the INS signal	None
Antenna size	812.8W x 406.4D mm	400.0W x 97.8D x 146.0H mm
HPA	Class-A HPA max 60W	Class-C HPA max 60W
LNA	Noise figure <1.8dB (at the temp 25 °c below)	Noise figure <1.8dB (at the temp 25 °c below)
Channel	C-channel(TX/RX: 2)	P(RX.1) R(TX:1)

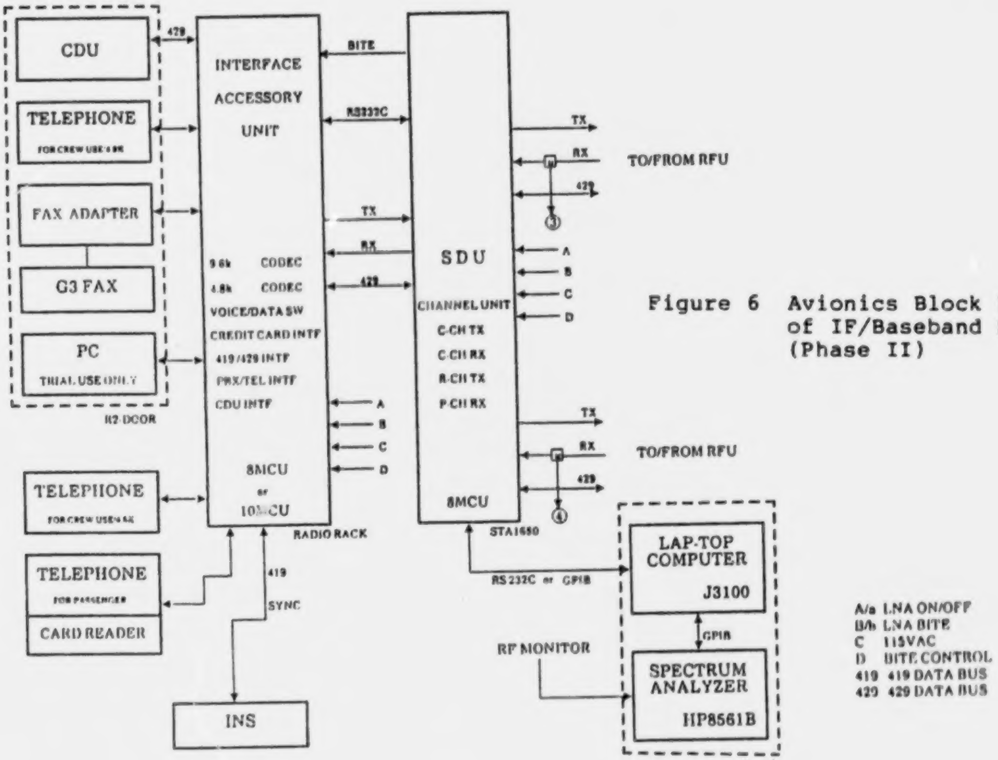
Table 4 Major parameters of AES antenna/RF subsystem (Phase II)

Functional block diagram of the antenna/RF subsystem and IF/baseband subsystem (the digital communication subsystem, the access control, signalling equipment and terminal equipment) are shown in Figure 5 and Figure 6, respectively. Equipment installation of AES is illustrated in Figure 7. AES system is composed of low and high gain system to complement each other, that is, low gain system is used for P/R-channel



LGA (TOP)
TX
RX
429
TO/FROM SDU
RFU
U/C
D/C
4MCU
STA1650
C
①
③
C-CLASS HPA
4MCU
STA650
DIP/ LNA
A B C
LOW SPEED DATA CHANNEL
HGA
a b c
a b c D 429
BEAM STEERING UNIT
(PORT)
SPLITTER
A-CLASS HPA
8MCU
②
HIGH POWER RELAY
D
STA1650
COMBINER
④
(STBD)
VOICE / HIGH SPEED DATA CHANNEL

Figure 5 Avionics Block Diagram of Antenna/RF Subsystem (Phase II)



CDU
TELEPHONE
FOR CREW USE 4.8K
FAX ADAPTER
G3 FAX
PC
TRIAL USE ONLY
R2 DOOR
TELEPHONE
FOR CREW USE 4.8K
TELEPHONE
FOR PASSENGER
CARD READER
INS
429
INTERFACE ACCESSORY UNIT
9.6k CODEC
4.8k CODEC
VOICE/DATA SW
CREDIT CARD INTF
419/429 INTF
PBX/TEL INTF
CDU INTF
8MCU or 10MCU
RADIO RACK
419
SYNC
BITE
RS232C
TX
RX
429
A
B
C
D
SDU
CHANNEL UNIT
C-CH TX
C-CH RX
R-CH TX
P-CH RX
8MCU
STA1650
TO/FROM RFU
③
④
RS232C or GPIB
LAP-TOP COMPUTER
J3100
GPIB
SPECTRUM ANALYZER
HP8561B
RF MONITOR
A/a LNA ON/OFF
B/b LNA BITE
C 115VAC
D BITE CONTROL
419 419 DATA BUS
429 429 DATA BUS

Figure 6 Avionics Block Diagram of IF/Baseband Subsystem (Phase II)

transmission for wide coverage, while high gain system is used for transmission of C-channel for high transmission rate. Low gain system is installed at STA-650, consisting of low gain antenna (0dBi: top-mounted), C-class HPA (output power 60W) and LNA (noise figure: less than 1.8dB). High gain system is installed at STA-1680, consisting of high gain antenna (12dBi: conformal) on both side of the fuselage, LNA and communication rack mounted above the cabin ceiling. Communication rack includes A-class HPA (output power 60W), RFU (Radio Frequency Unit: frequency convertor) and SDU (Satellite Data Unit: MODEM and ACSE). Terminal equipments such as telephone, facsimile and control unit are installed in cabin and cockpit. Table 4 shows major parameters of antenna/RF subsystem.

For the GES equipment, the digital communication subsystem is connected with the antenna/RF subsystem of Ibaraki Coast Earth Station. GES has a telephone interface with Public Switched Telephone Network (PSTN) via International Transit Switch (INTS), supporting CCITT No.5 signalling. INMARSAT describes whole protocol of access control by SDL (System Description Language). KDD has performed validation of INMARSAT SDL by means of validation tool developed by KDD Laboratory.

3.2.3 Test item

Major test items are shown below:

1) Verification of access control and signalling function of satellite link and function with connection/exchange function with terrestrial network
2) Measurement of L-band wave propagation characteristics of P/R channel in addition to C-channel
3) Evaluation of 4.8kbit/s voice codec's quality
4) Evaluation of real-time facsimile interface's quality

4. Commercial Services

Regarding commercial services, at present time, only terrestrial radio communication networks are available in HF and VHF bands for aeronautical communications. The aeronautical communications could be separated into the following four operational classifications:

a) Air Traffic Communications (ATS);
The ATS exchanges messages concerning distress, urgency, flight safety and regularity, and meteorological conditions.

b) Aeronautical Operational Control (AOC);
This is used for the initiation, continuation, diversion or termination of a flight in the interest of the safety of the aircraft and the regularity of the flight by aircraft operating agency.

c) Aeronautical Administrative Communications (AAC);
The AAC by aircraft operating agencies is used for communications related to the business aspects of the flight and the air transport service.

d) Aircraft Passenger Communications (APC);
This category would comprise all those communication services used by passengers for communications with the ground whilst the aircraft is in flight.

The aeronautical satellite communication system could provide all these services and offer the capability to improve channel capacity, quality and reliability for aircraft communications in many areas of the world. KDD plans to offer all these services except ATS. But the specification of aeronautical satellite communication system is now still discussed in the technical and operational aspects in many international organizations, such as AEEC, ICAO, CCITT, EUROCAEO and RTCA, etc. Some modifications of the specifications may be happened depending on the result of these discussions.

Our present plan is that the data service for AOC will be commenced from April in 1990, and the voice service for APC and AOC from the December in 1990 based on the current specification. Figure 8 shows overall configuration of commercial service by KDD.

A full-scale ground earth station for the aeronautical satellite communication services taking into account the final specification will be made by 1993. The full-scale ground earth station will support following functions;

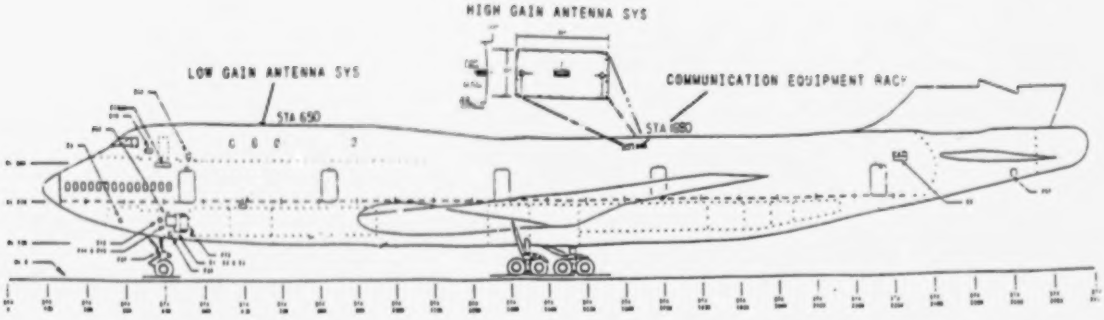

HIGH GAIN ANTENNA SYS
LOW GAIN ANTENNA SYS
COMMUNICATION EQUIPMENT RACK
STA 650
STA 1880

Figure 7 Equipment Installation of AES (Phase II)

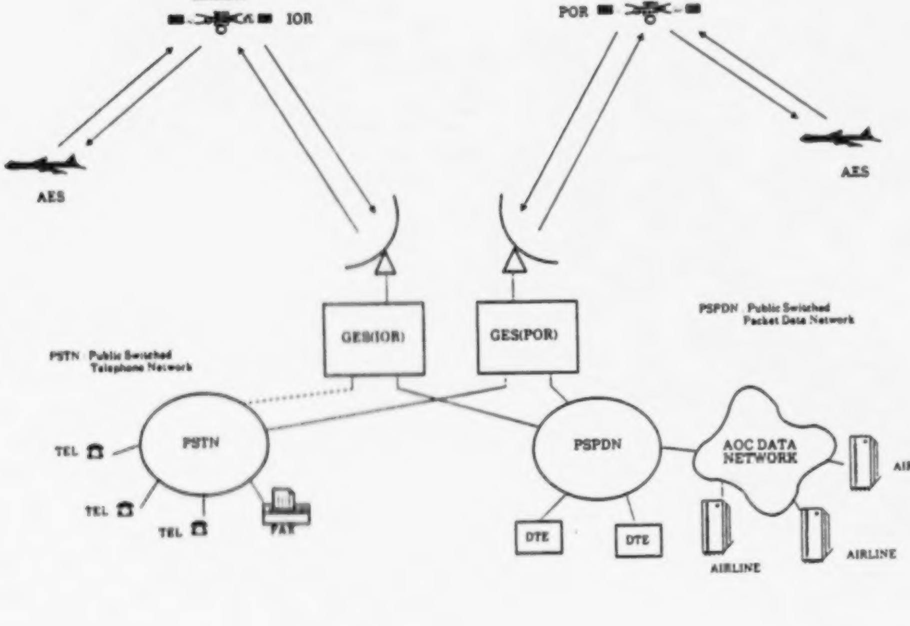

INMARSAT
Satellite
IOR
INMARSAT
Satellite
POR
AES
AES
GES(IOR)
GES(POR)
PSPDN Public Switched
Packet Data Network
PSTN Public Switched
Telephone Network
TEL
PSTN
TEL
TEL
FAX
PSPDN
AOC DATA
NETWORK
AIRLINE
DTE
DTE
AIRLINE
AIRLINE

Figure 8 Overall Configuration of Commercial Service by KDD

1) Higer data rate data channel
   (up to 10.5kbit/s of P/R/T channel)
2) X.75 (X.25) multi terrestrial
   interface with PSPDN and AOC
   data networks
3) Multi voice channel (C-channel)
   including facsimile
4) Common operation to POR/IOR

5. Conclusion

KDD in cooperation with MPT and JAL has proved that aeronautical satellite communication systems has significantly improved characteristics in terms of coverage and quality of communication compared with those of existing communication, through flight tests of Phase I program. Phase II program targets implementation of access control function both in satellite link and terrestrial link. At the same time, KDD plans to establish the global network of aeronautical satellite communications supporting telephone and data services in cooperation with COMSAT.

Since some system construction based on INMARSAT specification are under way including COMSAT-KDD group, it must be extremely important to work together with other service providers, avionics manufacturers and airlines for the interoperability.

DIGITAL RADIO SERVICE
-- MORE THAN CAR PHONES --

Charles J. Many
NYNEX Mobile Communications Company
Pearl River, New York

Car phones are the first of a series of wirefree personal and business communications products that will satisfy a number of basic 21st Century needs: to stay in touch...to control one's life...to be untethered...to improve quality time with family and friends by using non-productive time to perform essential personal tasks. In addition, digital radio access to the Public Switched Telephone Network offers the ultimate conclusion to Alexander Graham Bell's 100 year old vision, "to allow people to communicate anywhere and anytime."

The growth of car phones is accelerating throughout the world (see Figures 1 and 2). In the United States, the rate of growth has increased from 50,000 subscribers per month in 1987 to over 100,000 subscribers per month in 1989. At this time, the U.S. has passed the 1.25 percent penetration level with over 3 million phones in service.

Why does growth accelerate even though prices are still high? Is it simply a case of status? Another toy? The answer is no! Car phones are the first of a series of wirefree personal and business communications products that satisfy a number of basic 21st Century needs: to stay in touch...to control one's life...to be untethered...to improve quality time with family and friends by using non-productive or "dead time" to perform essential personal tasks. In addition, digital radio access to the Public Switched Telephone Network ("PSTN") offers the ultimate conclusion to Alexander Graham Bell's 100 year old vision, "to allow people to communicate anywhere and anytime."

Many people do not recognize these needs or the potential of wirefree communications to revolutionize the entire communications business. They perceive a car phone to be a "toy" for the rich, using a technology that is limited by weather, topography and available spectrum. These perceptions are the result of early market experiences and outdated technological theories. Fortunately for those of us in the wirefree business, there are many other people who see wirefree as a way to satisfy their business and personal needs. At the same time, worldwide technological developments offer the means to solve any technical constraints. Three particular world-wide technologies -- digital, microprocessor chips, and fiber optics -- will allow wirefree to become significantly more than just a car phone business.

This paper will discuss the following ingredients which will expand the use of radio beyond car phones:

- The substantial market need.
- The technical changes which will allow carriers to serve the need without more spectrum.
- The ability to have a seamless connection to the Public Switched Telephone Network.

MARKET

There are four distinct market needs which will be satisfied using wirefree technology. They are:

I. to be "in touch" with one's business;
II. to use dead time to improve the quality of one's life;
III. to provide new communications opportunities in situations where wire is impractical or impossible;
IV. to significantly reduce the cost of the last mile.

I. THE IN-TOUCH GENERATION

Although much publicity speaks to the video generation, one needs to recognize that in today's business environment, speed is essential. We live in an ever-shrinking world where it isn't good enough to be in touch in one time zone or even between 9 a.m. and 5 p.m. Businesses cannot afford to miss opportunities, and people have come to expect instant awareness of events in their market and the world. As a result, the desire to be in-touch, but yet in control (i.e. able to communicate when one wants to) is significant. The satisfaction of this need goes far beyond cars to personal communication services (e.g. CT-2 or DECT).

II. QUALITY OF LIFE

Today, 57 percent of the families in the U.S. consist of two workers. This number will increase to 62 percent over the next three years. The individuals in these families are hard-pressed for time, particularly quality time with family and friends. Today a considerable part of their day is spent away from wired communications. This dead time can be spent caring for chores previously done at home (e.g., scheduling doctor/dentist appointments, contacting relatives physically far away, etc.) enabling people to spend more quality time with those they love. Once again, this should not be thought of as car commuting but rather the

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ability of personal communications to make time away from home or office more productive.

III. NEW COMMUNICATIONS OPPORTUNITIES

There are a number of business opportunities which have been impractical due to technology and/or a lack of communications capability. Here are some clear examples related to vehicles and traffic control:

1. Most modern vehicles, particularly mid- to high-priced units, are controlled by highly sophisticated micro-computers. This capability allows one to download programs from larger mainframes to do remote diagnostics, detect potential failures, and alert the owner to see the dealer before a failure occurs.

2. If a failure does occur, remote diagnostics on the vehicle will allow the dispatch of a repair person with significantly more information and the correct part.

3. Widespread vehicle locate as well as faxing maps to limousine or delivery drivers are clear differentiators that make one's business more efficient.

4. The collection of traffic information for the control of warning signs, traffic lights, and the provision of information to law enforcement agencies.

5. Personal location for safety or emergency.

The above opportunities and many more are made possible by micro-computer technology, and the fact that digital technology will provide significant increases in the capacity of available spectrum.

IV. THE LAST MILE

The final market opportunity, which may prove to be the largest, is the replacement of the residential loop. If we reflect on the evolution of the PSTN, we see that much has been done to improve and make less costly the network from the originating mainframe to the terminating mainframe. But the loop is (for the most part) the same pair of wires that existed in the early 1900's. Certainly we have progressed from fence wire to twisted pair, and from party lines to multiplexing, but the demand for universal service has only served to complicate and make costly the installation, maintenance, and record-keeping functions of the loop. Furthermore, rodents still like to chew the cable; vehicles and weather knock it down; and contractors dig it up. It is labor- and capital-intensive. On the other hand, radio access network offers a network without wires, loop monitoring systems, loop testing systems, mainframes, mainframe databases, and, most important of all, large quantities of people.

SPECTRUM EFFICIENCY

Figure 3 shows the capacity of the cellular network in New York City during the last three years. Clearly, closer spacing of cells (mini-cells) and the concomitant improvements in interference control and engineering-- not additional spectrum-- have been the dramatic drivers to increased capacity. In 1991-1992, the world will move to Time Division Multiple Access ("TDMA"), which will increase capacity by 4 to 10 times. Other technologies, such as Code Division Multiple Access ("CDMA") using microchip technology to increase the computer/memory power, offer the potential for 20 to 40 times today's capacity. At the same time, fiber optics will be used as the transmission medium between the computer, the radio, and the antenna. The result will be the introduction of micro-cells which will drive the capacity and availability of the existing 25MHz of spectrum to millions of subscribers in each city.

Eventually, 1990 technologies such as CDMA may even offer capacities above 10 million using the same 25MHz of spectrum. The technologies offer the possibility of eliminating the interference problems, reducing the per subscriber cost, and reducing the cost, size, and power requirements of the communications device. Ultimately, the radio wristwatch will be a way of life in the 21st Century and people will look back at today's communication devices as antiques to be placed in the telephone museum.

ACCESS TO THE PUBLIC SWITCHED TELEPHONE NETWORK (PSTN)

The final ingredient in the explosion of wirefree will be its integration into the PSTN so that the user experiences no difference between wired and wirefree access. Once again, technology and focus favor the radio business. Initially, as in the case of the telephone network before the 1920's, operators provided the switching. Today, most radio networks are a simple star network with a PBX-like access to the PSTN (see Figure 4). The system and design is radio-focused because the problems to date are interference-related. In the 1990's, we will begin to see the focus shift to the network side of the business. The cell site controller will be separable from the radios, and the large cities (New York; Los Angeles; Chicago) will have several switches interconnected (Figure 5). Fiber will allow one to separate the antenna from the radio. Thus, the term "micro-cell" will not only mean closeness but also smallness. This will significantly simplify the most difficult carrier problem "land control" and allow the carrier to easily and inexpensively fill the gaps that are either god- or man-made. In addition, Signalling System 7 ("SS7") will be introduced (Figure 6). This will provide two capabilities. First and most important, the mobile carriers will be able to interface to the PSTN as a local telephone company. Secondly, customer databases will be on the network and accessed via SS7. This will allow seamless operation and enable subscribers to roam universally. People will be automatically registered when they enter an area as the serving carrier uses SS7 to download the customer database (feature sets, etc.) from his/her home carrier.

WHAT DOES THE EVOLUTION MEAN?

By the mid-1990's, cellular carriers throughout the world will be able to serve 2.5 to 3 million subscribers in any city and in the 21st Century capacities will exceed 10 million. This will provide a capability for 50 percent penetration in Los Angeles and New York, and 100 percent penetration in cities like Miami and San Francisco. This capability and the market needs will drive carriers to introduce personal communications, vehicular locate, traffic control, alarms, etc., without the need for additional spectrum.

Furthermore, two phenomena will make wirefree residential access a reality. First, the existing wire providers on a world-wide basis will raise the access price to eliminate the business/residence cross-subsidy. These wirefree carriers must increase the price of access close to the cost of the access or they will be relegated to provide residential service only. At the same time, the cost of providing a wired loop will stay constant or increase, while the cost of radio access will decrease because radio has significant possibilities for technological improvements, and it is not labor intensive. Thus, there will be a business condition which will allow radio carriers to compete with the existing telephone company by providing a radio overlay network.

In conclusion, a communications environment where a user will be able to communicate anywhere to anyone with the same ubiquity of service as he or she experiences in their home or office is fast approaching. The opportunities offered by wireless are only limited by our imagination.

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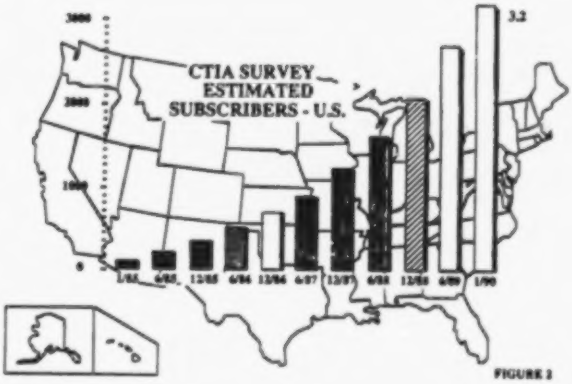
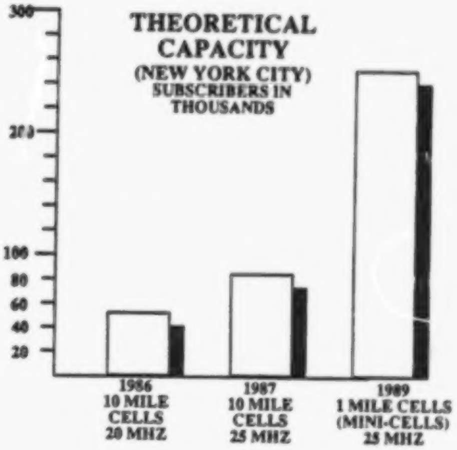


FIGURE 2



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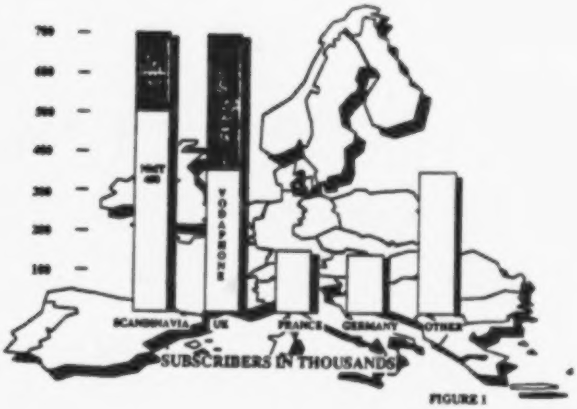

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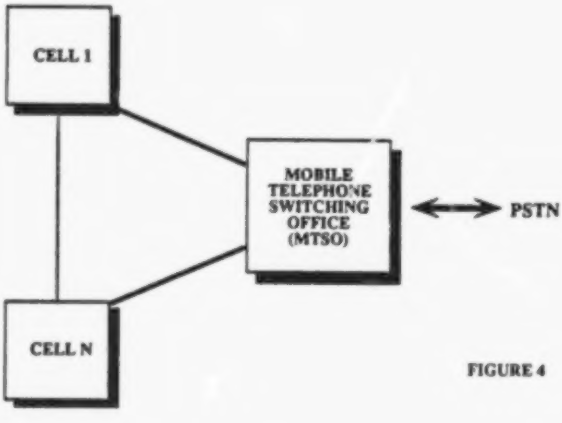

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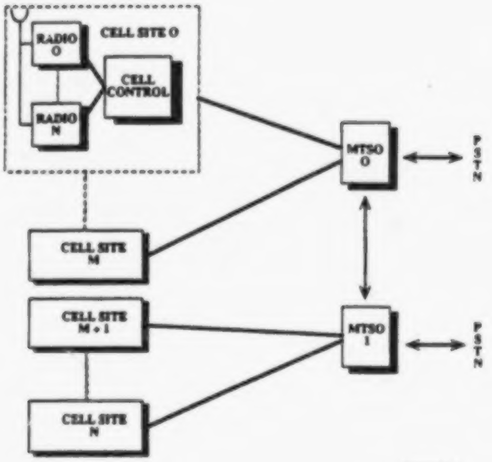
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RADIO O
RADIO N
CELL CONTROL
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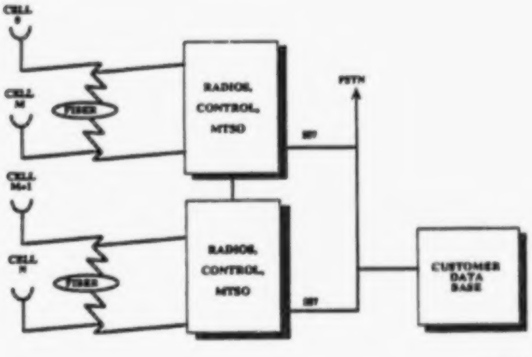
PSTN
CELL SITE M
CELL SITE M+1
MTSO 1
PSTN
CELL SITE N

FIGURE 5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SS7
PSTN
CELL M+1
CELL N
FIBER
RADIOS, CONTROL, MTSO
SS7
CUSTOMER DATA BASE

FIGURE 6

The Evolution of Ubiquitous Global Mobile Voice and Data Services - The Promise and the Issues

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Abstract

As we approach the 21st century, the true potential of satellite communications is about to be realized with the introduction of affordable, wide-area, thin route communications to mobile and personal earth terminals. The last 25 years have seen phenomenal technological progress in, to name just one area, reducing earth station antennas from 30 metres in diameter to a size that can be hand-carried.

As mobile communications services become available they offer the promise of global networking without regard for location and a market size that is orders of magnitude larger than what exists today in the satellite communications industry. It is anticipated that the true benefits to be derived will not accrue from voice services but rather the broad range of data applications for navigation, position location, distress and emergency communication, system control and data acquisition, to name just a few. The capability of offering simultaneous voice and data may also play an important role in adding to the list of services offered to mobile earth terminals.

Naturally, there are few good things that come without their price. The issues confronting mobile services by satellite are the need for better technology, both in electronic devices and components and in the techniques used to employ them. With a large population of mobile terminals (in the thousands) the need for network control reaches new dimensions since the transceivers will have to be consumer goods rather than labour intensive commercial quality. While WARC-MOB-87 allocated L-band spectrum to mobile satellite services, there remain questions as to the adequacy of the allocation and the importance of equipment and system standardization among the international and regional systems being launched.

Introduction

In the telecommunications industry, there are three main keywords; namely, transmission, switching and access. Transmission refers to how voice and data signals are shunted around the world according to some algorithm that determines signal routing, otherwise known as switching. Historically, transmission consisted of copper pairs, radio, wideband satellite links, etc. and switching was comprised of intelligent nodes in the network that compute which transmission paths can be tandemed to form a communications link between two points on earth. The evolving philosophy in the industry centres on access: how do we access the fixed backbone network from wherever we might be and whenever we so desire. The focus is on individual persons, vehicles and implies narrowband access for both voice and data to use the wideband backbone network. Individuals require voice access and perhaps a certain amount of data access to satisfy the needs of their remote terminal, personal computer or vehicle sensor package.

This paper takes a long term, global view at the subject of communications access which may be the key to resolving many of our current requirements of developing a truly global, ubiquitous mobile/personal voice and data communications capability. The solutions are multi-disciplinary; some using terrestrial techniques, some by satellite, both using a variety of technologies and techniques. While the high technology items hold forth many benefits and promises, we have to address also social and economic realities, community requirements and personal needs, as well as the current state of technology and its evolution to properly address the question of whether these advances are viable in light of advances in ISDN, broadband access techniques, fibre technology, network intelligence and so on. While the focus of the paper is on mobile satellite services because of the nature and breadth of the Pacific Ocean, the concepts and the applications are equally applicable to the evolution of personal communications within the context of cellular telephone systems, which find popularity in urban, densely populated areas of the world.

Services and Technology

Transportable, portable and personal communications implies wireless access to the existing communications infrastructure. Wireless, in turn, means radio or the use of the electromagnetic spectrum and energy to reliable and efficiently convey messages from source to destination. In North America, wireless systems operate in many bands; public systems operate in the 150 MHz, 450 MHz, 800 MHz and 900 MHz bands as licensed by regional/national authorities. More recently, WARC-MOB-87 approved the use of the 1.5/1.6 GHz bands for mobile satellite use globally which has been adopted by both the FCC (USA) and the DOC (Canada) to provide services to land, maritime, and aeronautical terminals in North America. INMARSAT operates voice and telex services to maritime users in the Atlantic, Indian and Pacific Ocean regions of the world. Other organizations have plans to launch mobile communications networks regionally; most notably, Australia (AUSSAT), Canada (Telesat Mobile Inc.), USA (American Mobile Satellite Corporation), Japan and the European community via the efforts of the European Space Agency.

Most systems will support narrowband access for both voice and data; low bit rate voice and up to 1200 bps of data. While voice is a well understood service type, data can fall into one of several categories; namely, real-time and message format. INMARSAT, Qualcomm (USA) and the early mobile data systems to be launched in 1990 by TMI (Canada) and AMSC (USA) offer message or "store and forward" services whereby a message may take several minutes or a fraction of an hour to reach its destination. Real-time data services imply that a mobile user can have an interactive session from his/her terminal with the corporate mainframe in real-time. In British Columbia and North America today, real-estate agents, sales persons, mobile fleet operators are demanding economical data services to mobile terminals to offset the high air-time charges of exchanging relatively small amounts of data on a circuit switched connection. Extending this concept to SCADA (system control and data acquisition) systems opens up the imagination of service planners and potentially a huge market. Visualize the number of LANs (local area networks), mobile or portable, with their limited processing ability, that could be networked with their corporate and/or institutional bases to exchange global intelligence and information in the form of remote real time data and centralized mainframe processing power to create powerful operational and business tools.

As for voice, the Pacific and the Pacific Rim countries should be the first to appreciate the concept of personal voice communications in accessing the telecommunications networks of the world. The projected cost of satellite earth terminals is in the order of $5,000 Canadian, initially, and when volume production is in place, this cost will drop to at least $1,500 Canadian, which is well within the range of a cellular, portable telephone. Contrast the above price for a mobile terminal with the $50,000 cost of a fixed earth station accessing a C or Ku-band transponder.

The technologies and networking techniques to realize personal communications are well within reach. In the area of satellite communications, the focus is on inexpensive, efficient antennas, high gain spacecraft amplifiers and efficient (power and bandwidth) modulation techniques including high performance low bit rate voice codecs. Terrestrially, many of the same technologies apply to cellular telephone systems, other than perhaps the need for small, high gain antennas to implement truly personal communications.

One of the key issues facing both terrestrial and satellite approaches is spectrum and its utilization efficiency. In the case of satellite based services, WARC-MOB-87 assigned 34 MHz at L-band (Figure 1) to be shared by land, maritime and aeronautical services. Terrestrially, in North America, public access cellular systems operate in the 800 MHz band and current trends indicate that some systems are totally saturated, particularly in high density urban areas. Clever techniques to reduce cell size, low bit rate voice to reduce bandwidth are intended to increase system capacity. The 34 MHz assignment by WARC-MOB-87, while adequate for today's market, may not be sufficient to serve a mature market, say in the year 2000. If the popularity of cellular telephones is repeated in the development of mobile satellite systems, then the issue of spectrum and spectrum sufficiency will arise over and over again. The development of data access techniques for mobile users (terrestrial and satellite) has spawned the development of a variety of applications or value-added services that extend well above layer 3 of the OSI (Open Systems Interconnection) hierarchy.

The potential volume of this data traffic, while as yet unconfirmed, may prove to be much larger than the amount of voice traffic and may turn out to be the true driver in the evolution of mobile and personal telecommunication services and systems.

Systems and Networking

The last decade has seen numerous technological advances in the telecommunications industry. Broadband fibre optic networks ring the world in conjunction with more powerful and complex satellites and satellite networks. While there is some agreement that broadband end-user network access is the secret to success incorporating broadband ISDN, integration of voice/data/video services, there is much work in progress to address the narrowband, wireless access to extend communications, particularly voice and data, to the person and not just a fixed telephone/terminal that cannot move.

Some of these wireless access techniques and systems are shown in Figure 2. The cordless telephone and cellular systems with handheld transceivers are the first generation of systems to address the growing need for personal communications. In North America, GTE Airfone and Skytel (Canada) are in the process of re-designing the original public access communications system to serve the needs of airline passengers in transit. MSAT or mobile satellite systems are entering service and will provide similar narrowband, wireless access to the public. With time and continued intense R&D efforts, cellular systems will be overlaid or replaced by micro-cellular systems for personal communications and have some of the attributes of current cellular and cordless systems. The key to widespread deployment of terrestrial systems is economic coverage; that is the installation of base stations to interface the wireless access systems to the fixed network. Mobile satellite systems are not constrained by geographic coverage limits but by the high capital cost of the single "repeater-in-the-sky" and distributing this cost over a customer base. The need for LBR (low bit rate), toll quality voice systems is crucial, much more so than in fixed terrestrial systems where 16 or 32 kbps represents an infinitesimal proportion of the available bandwidth of a fibre optic trunk system.

Narrowband, wireless access systems are totally synergistic with the evolving broadband systems. While there is a school of thought that maintains that broadband, customer controlled access will be pivotal, particularly in a deregulated environment, there is growing acknowledgement that solutions to both the broadband and the narrowband access issues cannot be separate. Narrowband, wireless access, by satellite or otherwise, represents the "last mile" that gives people mobility. Because individuals can source/sink limited amounts of information, be it voice or data, the access, at present, is narrowband. As communication services mature, perhaps there will be a need for broadband mobile/portable access at some point in the future.

All of the systems developments shown in Figure 2 are currently proceeding semi-independently. When they all mature, we will have multiple, non-compatible wireless access systems and standards. This is true not only in the case of regional mobile satellite systems but also in the evolution of the second generation digital cellular systems in Europe, North America and Japan.

The current and evolving systems shown in Figure 2 are, at present, not interoperable due to globe regulatory, institutional and other differences. Perhaps the global telecommunications industry, regulators, system suppliers and service operators should consider a generalized access model that will accommodate all of the proposed techniques irrespective of their range, coverage or implementation technology. Such a model would focus on the user interface; that is the telephone handset or terminal interface and allow it to interconnect transparently to the wireline network as shown in Figure 3. The end user will provide his/her own personal communicator handset and access the wireline network via any one of the techniques shown whether MSAT, Airfone, Cellular or a direct PCN (Personal Communications Network) interface. Protocol conversion, number translation, etc. are not foreseen as major issues given that the telecommunication network will be software and database intensive. By segmenting these techniques and identifying clear and logical demarcations, the mystery of resolving the method of access becomes user controllable and selectable depending on local/regional regulations and available options.

At present, in North America, there is intense competition in the sale and distribution of cellular compatible handheld portable telephones. While the introduction of cellular telephones created the concept of a "roamer", these roamers were restricted to the highway system for the most part. Consider now the situation in which MSAT transceivers or personal cellular telephones can truly travel around the world and become "super-roamers". Since the majority of the user community is not communications literate, many users will not understand why their personal unit will not work in different parts of the world. The International Civil Aviation Organization (ICAO) has recognized this issue and has embarked on a program (Future Air Navigation Systems - FANS) to define a common access and operating standard throughout the world for use by its member states and the aeronautical industry in general. Perhaps the mobile satellite industry and the cellular system industry should examine ways in which their respective services could become truly complementary rather than mutually exclusive.

The design and specification of a North American mobile satellite system developed considerable momentum over the last several years since the allocation of spectrum by WARC-MOB-87 and the respective creations and incorporation of both Telesat Mobile Inc. and the American Mobile Satellite Corporation. Services to be offered fall into four main categories; namely,

- mobile telephone service (MTS)
- mobile radio service (MRS)
- mobile data service (MDS)
- aeronautical mobile satellite service (AMSS)

MTS and MRS are primarily voice services which differ in that MTS users have full dial access into the North American public switched telephone network (PSTN). MRS is designed for private, user groups for such applications as fleet management in which mobile traffic is hubbed to a private network earth station and users have limited off-net (i.e. PSTN) access. Fixed earth stations serving MTS users will be distributed around North America and the system will determine the terminating fixed earth station in order to minimize the terrestrial toll backhaul charge to reach a station connected to the PSTN.

Mobile data services will fall into two subsets to provide service to private user groups and to subscribers of a public access data network. Both store-and-forward message traffic and fully interactive packet traffic will be supported to serve the needs of near-real time users and real-time interactive customers. Aeronautical mobile satellite services are identified as a separate service category, serving both aeronautical voice and data users but adhering to the ICAO global standards and specifications.

In the terrestrial environment, cellular telephone service is growing at an exponential rate since its deployment in the early 1980's. While service has been predominantly voice, recent years have seen the deployment of mobile data networks as specialized mobile radio systems in the 900 MHz band. MPR Ltd. has recently announced the development of a packet data interface for public access cellular systems that will allow the exchange of data, in packet form, between mobiles and base stations. The main distinguishing feature of the system is that unlike Mobidata and Mobitex, the user transceiver does not need to be replicated for voice and data, but that small retrofit to a conventional cellular telephone will enable the subscriber to access Datapac services (on a packet switched connection) via a dedicated circuit in each cell. One circuit/channel is estimated to be sufficient to support in the order of several hundred packet switched data mobiles assuming typical interactive sessions with no abnormal statistical deviations in traffic demand. Cellular network customers can now have the traditional voice service plus economical data transmission service. The new data interface permits the service operator to reduce the cost of an interactive data session by charging on a per packet basis rather than the more conventional circuit-switched airtime charge. For those of us who regularly use terminals and personal computers in our daily lives, we can appreciate that our data transmission costs will not be a function of our "think" time or individual typing speed during which little or no channel activity is present but yet the meter is running.

There is a vast potential market for SCADA (system control and data acquisition) applications in remote land and maritime environments. While the remote stations may not be mobile, these applications have not been adequately served due to their relatively small amount of data traffic and their remoteness. At one point in time, low cost VSAT networks where proposed, even field trialed to serve SCADA needs but were ultimately too expensive, in the order of $10,000 per station, to serve a sensor package that transmitted/received in the order of 256 bytes of data per hour at most. Quick calculations show that the per remote throughput is 0.57 bits per second which would grow to 4800 bps for an 8000 odd sensor package network. SCADA networks, for most applications, need to be real-time and have high availability which has not been economically possible to-date using land-line or VSAT satellite networks.

MSAT mobile data services are ideal for serving the SCADA markets. One of the issues is to develop a universal data interface for an MSAT transceiver that would satisfy all or as many as possible, diverse SCADA applications and environments. At the present time, there is much activity in the area of vehicle navigation and information systems to develop user applications and real-time control systems that require a reliable and economic two-way communications link to a mobile sensor package. This is one of the applications areas which has great potential as we approach the 21st century.

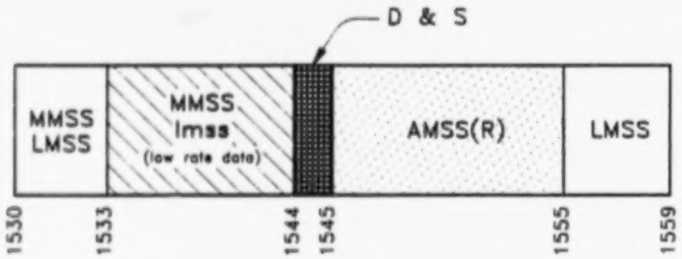
Systems/Networks Integration

With the broad diversity of developing systems and networks, the question arises of how does a user select a system or network to satisfy his/her requirements. The answer is not trivial and is related not only to the technology being used but also to the way these systems will be introduced to the marketplace. At present, most systems are designed to serve one market segment and access function such as cellular telephones provide telephony voice to land mobiles primarily in urban regions of the world. Aeronautical and maritime mobile services must use satellite technology to overcome the coverage limitations of VHF/UHF radio and the unreliability of HF radio around the globe. But it is feasible to consider that two separate systems/networks be interoperable such that the current cellular handset can be used with a mobile satellite system when out of range of a terrestrial cellular base station?

The solution lies in formulating a framework that will allow systems to be interoperable by specifying logical interfaces among most or all evolving "niche" systems. Global standardization requires that all potential users have access to the established network infrastructure without regional, political or economic discrimination. Figure 3 outlines a potential framework that categorizes access by distance and technology and may be the basis for standardization activities.

By embracing the goal of personal communications, one buys into the concept of providing voice and data services to individuals, the "super-roamers" without regard to the technology being used. In fact, whether the system is terrestrial or satellite based should, and will, become immaterial to the end user. Extending this discussion into the future, then we should begin looking at ways of providing some form of system compatibility or interoperability in order to serve the global market.

Sharing of the electromagnetic spectrum is unlikely to form the basis for integrating the services of multiple networks. Spectrum sharing is a problematic technique which raises many problems as in coordination procedures between C-band and terrestrial and satellite systems. Most of us who have worked in the communications industry shudder when faced with the prospect of finding or clearing a C-band satellite earth station site in an urban area.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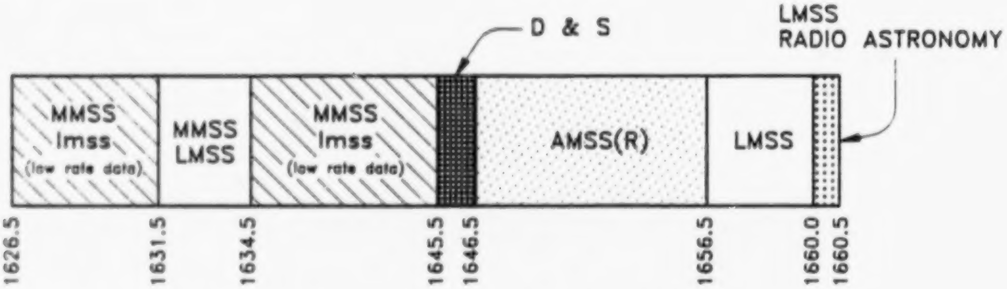
SPACE-TO-EARTH (DOWNLINK)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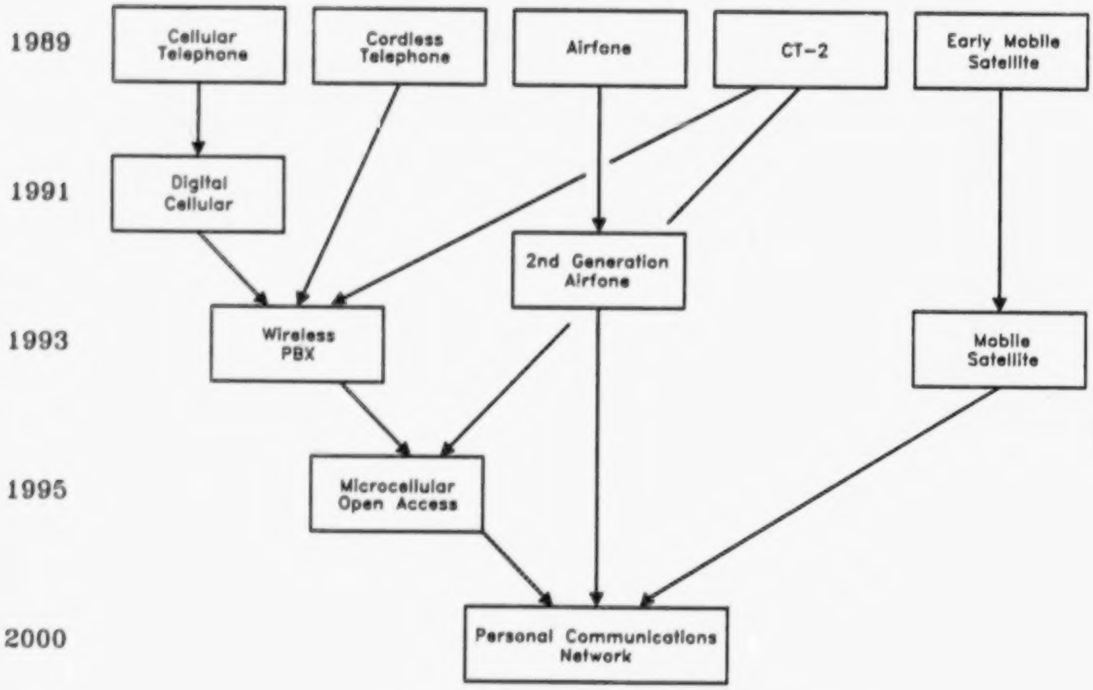
EARTH-TO-SPACE (UPLINK)

WARC-MOB-87 MOBILE SATELLITE SPECTRUM

Figure 1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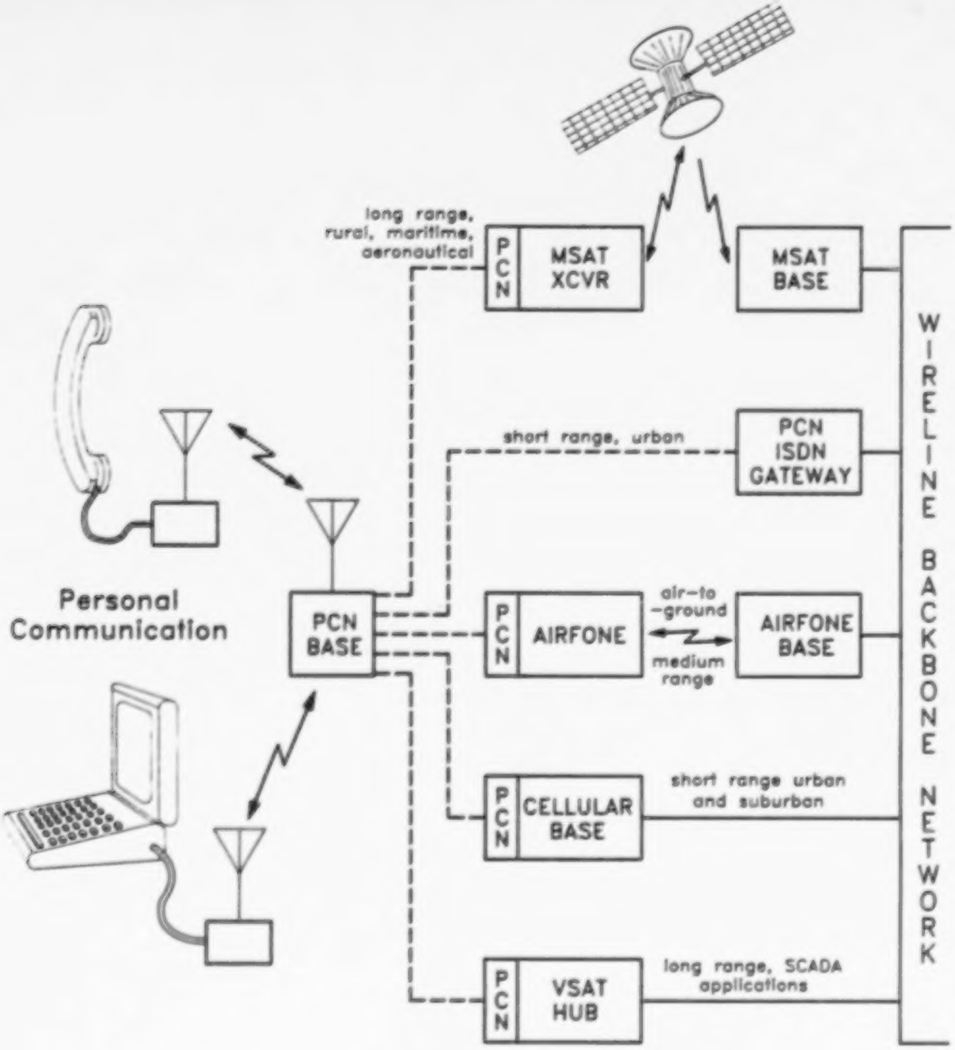
Cordless Telephone
Airfone
CT-2
Early Mobile Satellite
Digital Cellular
2nd Generation Airfone
Wireless PBX
Mobile Satellite
Microcellular Open Access
Personal Communications Network

PERSONAL COMMUNICATIONS EVOLUTION

Figure 2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PCN
MSAT XCVR
MSAT BASE
WIRELINE BACKBONE NETWORK
short range, urban
PCN ISDN GATEWAY
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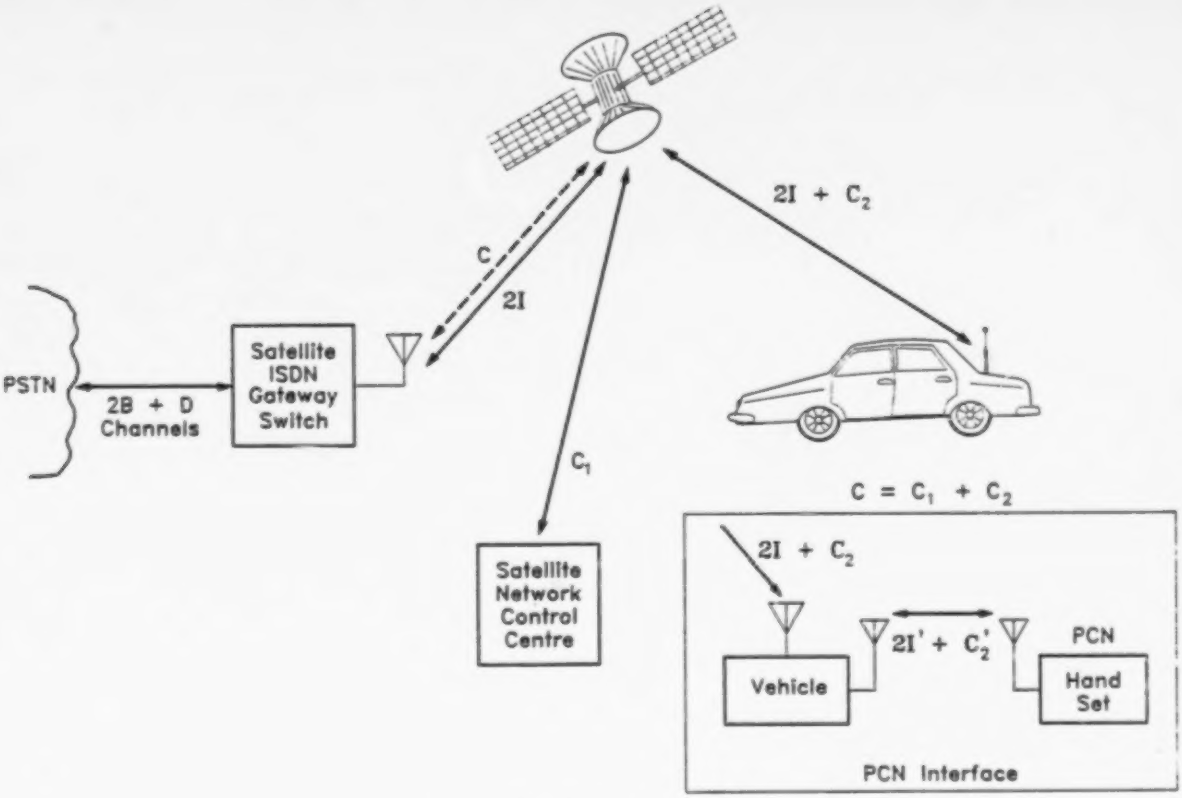
PCN
AIRFONE
air-to -ground
medium range
AIRFONE BASE
short range urban and suburban
PCN
CELLULAR BASE
long range, SCADA applications
PCN
VSAT HUB

PERSONAL COMMUNICATIONS EVOLUTION
Figure 3

However, it should be possible to find commonality or partial interoperability at the baseband level of the various systems. Research and development into low bit rate voice coding algorithms is essential to any wireless communications system to use the assigned spectrum efficiently and still provide good quality. System access and signalling techniques are other areas where commonality would be beneficial. Having the facility of using two or more systems depending on the location of the transceiver ensures truly global coverage. In the data communications world there are common standards to define network access at the lower three levels of the ISO 7 layer hierarchy. Perhaps some of the broadband ISDN concepts for network access should be adopted to unify access to different networks providing narrowband personal voice and data services.

The concept of mobile ISDN should not be ignored. Figure 4 illustrates a possible implementation of mobile ISDN via an MSAT satellite. The concept is based on 4 wire voice, hence 2I, where I denotes a one-way voice or data channel. C denotes a control link for network management and includes both network and service (line) supervision functions. A possible interface to a personal communicator (PCN) is shown inset in Figure 4.

One aspect to keep in mind in this evolution is that large, widespread satellite networks will require mass produced consumer electronics which is breaking with traditional commercial quality devices requiring human labour to fabricate, test and configure. The cellular telephone industry overcame this hurdle; however, they did not have to deal with the possibility of one transceiver affecting the performance of the entire network, just one cell. In the case of mobile satellite systems, a recurring nightmare exists in which one mobile transceiver affects the performance of the satellite and, hence, the network. There has been and there will be much effort put into the design of a fairly stringent network management system to deal with this type and other related anomalies.



MOBILE ISDN

Figure 4

Summary

There is no disagreement that mobile satellite services will have a major impact on the communications industry into the next century. Equally so, the rapid growth of terrestrial cellular networks and the development of the second generation digital standard will continue to cater to the communications industry. Ultimately, all of these techniques and technologies will converge to satisfy personal communications needs in offering universal voice and data services worldwide.

The impact of mobile satellite communications services will be greatest in those parts of the world which are remote and cannot justify the installation of terrestrial facilities. MSAT, by definition, means mobile but it really offers narrowband access to the backbone network which is a key requirement in the Pacific basin, northern and central Canada, the US prairies, in Europe, in Asia, Africa, as well as on the oceans and on transoceanic aircraft.

The key issue in achieving our goal of truly personal communication, by satellite and terrestrially, are the availability of spectrum (perhaps in other frequency bands), the continued investment in technology and in the techniques used to implement the technology and design of strategies to control the network. In contrast to "high-tech", there are "low-tech" issues to be resolved; namely, regulatory and territorial debates, market partitioning, agreed upon access methods, intercarrier relations. The future, both near term and long term, holds forth many benefits and some interesting challenges to overcome.

POTENTIAL OF THE INMARSAT STANDARD-C SYSTEM IN THE PACIFIC REGION

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1. ABSTRACT

Since its inception in 1979 and the commencement of global operations in 1982, Inmarsat has expanded its mandate to serve aeronautical and land mobile communities in addition to maritime users.

The new Standard-C system with its light weight, low cost terminal and global coverage promises to expand significantly the reach of mobile communications.

In a vast region like the Pacific, no doubt many new applications will be stimulated. This will be facilitated by pre-operational service in the Pacific Ocean Region, followed by full commercial service through Land Earth Stations operated by Inmarsat's Signatories in the region.

Potential applications include global electronic office, multimodal container management system, remote data reporting among many others.

2. INMARSAT

Inmarsat was established in 1979 to provide space segment for world-wide maritime satellite communications and radio determination services. Global operations began in February 1982 and the organization has since enjoyed significant growth in traffic volumes. The organization is an intergovernmental partnership, whose members now total 57 countries from all parts of the globe. Each member country nominates a Signatory to Inmarsat, typically but not always the PTT. The Signatories invest in the satellite system according to their usage of the system.

In October 1985, the Inmarsat Assembly of Parties unanimously approved amendments to Inmarsat's Convention and Operating Agreement to give the Organization the institutional competence to provide aeronautical satellite communications services. These amendments become effective in October 1989 after two thirds Inmarsat member countries representing two thirds of the total investment share in the organization formally accepted them.

Following the WARC MOB-87 allocation of frequencies for land-mobile services, in January 1989, the Inmarsat Assembly of Parties approved another set of amendments to the Inmarsat Convention to give the organization the institutional competence to provide land-mobile communication services.

In short, in a span of ten years, the purpose of Inmarsat has expanded to being the space-segment and system provider for a complete, comprehensive and worldwide set of mobile satellite services for all mobile user communities - maritime, aeronautical and land. This evolutionary process has enabled, in a very cost effective manner, an early start for aeronautical and land-mobile satellite services.

Presently, some 10,000 Standard-A terminals, capable of analog voice, telex, facsimile and voice-band data are in use on ships, on maritime structures and on land. The pre-operational phase for aeronautical voice and data and land-mobile data services has already begun in 1989; the operational services are poised to begin, on a worldwide basis, in 1990.

Being an international "not for profit" cooperative dedicated "exclusively to peaceful purposes", Inmarsat provides member Countries (Parties) as well as non-member countries with non-discriminatory access to the full range of "never beyond reach" mobile satellite communications services. Inmarsat caters to the vital safety services on an international basis. It plays a useful and often vital role in various safety related systems and initiatives such as the Global Maritime Distress and Safety System (GMDSS); the hosting of the secretariat for the COSPAS-SARSAT system; Air Traffic Control applications to meet the needs identified in ICAO's Future Air Navigation Systems (FANS) Committee report; and the provision of a geostationary integrity augmentation of national GPS and GLONASS navigation satellite systems for international civil users.

3. THE SYSTEM

At present, operating primarily with Standard-A terminals, the three major components of the Inmarsat system are (see Figure 1):

the **Space Segment**, with eight satellites, covering the entire globe except for the polar regions and the associated TT&C, operations control and network co-ordination ground support facilities - all operated by Inmarsat;

the **Land Earth Stations** (LESs), generally funded and operated by the Signatories, are the interface between the space segment and the national and international fixed telecommunications networks; and

the **Mobile Earth Stations** (MESs) are the satellite communications terminals, purchased or leased and used by individual customers. So far there are about 10,000 MESs in use around the world, on vessels from more than 80 countries, using telephone, fax, telex and data communications facilities provided by Inmarsat in the L-band, that is the 1.5-1.6 GHz frequency band.

Inmarsat presently operates satellites in a three ocean region configuration, providing near global coverage except for the polar regions and some northerly and southerly areas of the Americas and neighbouring ocean regions. This coverage, which is shown in Figure 2, will be further improved by the implementation of four region operations expected to be in place by the end of 1990.

4. STANDARD-A MES

MESs are as easy to use as ordinary telephone and telex machines. The call is relayed to the LES through one of the satellites and then fed into the appropriate international network for connection to its destination. A country without an LES is not precluded from using the system - it only needs routing agreements with countries that do have one.

Almost all MESs in operation use Inmarsat's Standard-A system. Intended primarily for ocean-going vessels, Standard-A MESs typically cost about US$30,000, weigh between 50 kg and 100 kg and have antennas nearly a meter in diameter.

On account of its versatility, the Standard-A MES is used extensively on land as well. Portable MESs are used for co-ordinating relief after natural disasters, such as in Mexico City and in the Colombian town of Armeroin 1985; in Armenia, in Africa and in the disastrous oil spill from the Exxon Valdez in Alaska in 1989. They are a vital connection for the research teams posted in the Antarctic and mountaineering teams conquering the Everest.

Here in the Pacific basin there are Standard-A MESs registered in a large number of countries in the region and many more are used in the area by companies from abroad to supplement local communications.

Of course, such terminals are not necessarily suited to all vessels and all occasions, either in terms of economics or simply in terms of size. Nor do all users require the level of communications available through the Standard-A system. To provide communications for a wider market, Inmarsat has recently developed a new standard, Standard-C.

5. THE STANDARD-C SYSTEM

Standard-C is an advanced, packet data communication system using a small low cost mobile earth station (MES) permitting message communications anywhere in the world. The system interconnects with both public and private (Closed User Groups, CUGs) networks to provide international, regional or national services.

The Standard-C MES is a versatile low-cost, very compact, mobile satellite data terminal (-23dB/K) for maritime as well as land-mobile two-way, low bit rate (600 bits/second) message data communications on a store-and-forward basis, designed to interface with the international telex network and a wide range of terrestrial data networks (X.25, X.400). It also offers a number of other optional services: Polling (individually, group or area directed), Enhanced Group Call (EGC) such as SAFETYNET and FLEETNET, Data Reporting (position reporting, meteorological observations, equipment performance monitoring), distress alerting, etc. Its transparent packetized message transmission method and flexible protocol design means that it will be able to accommodate a wide range of new service enhancements in the future.

Figure 1 : The Inmarsat System

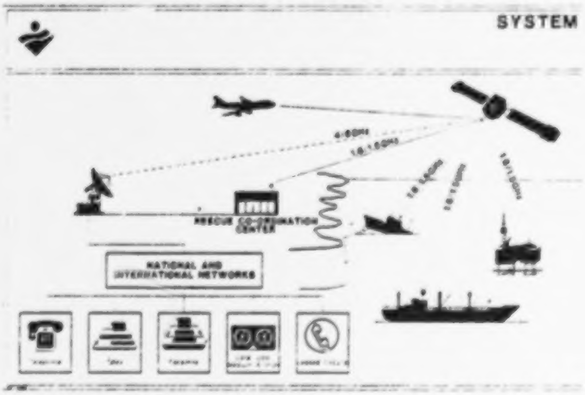
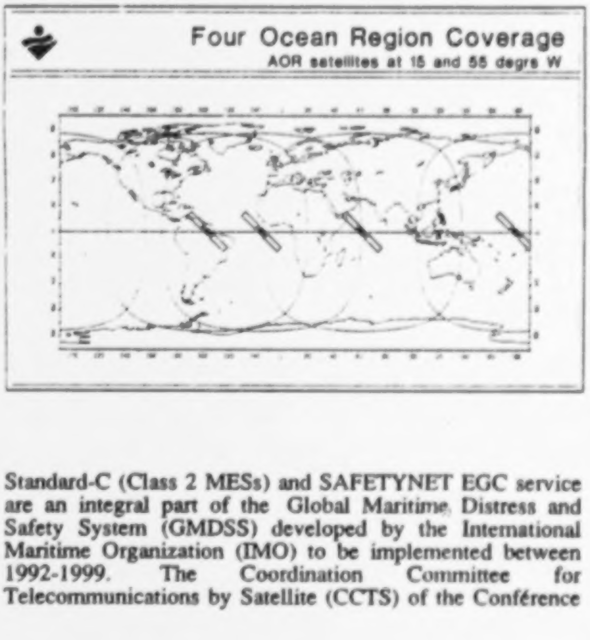

SYSTEM
4-6GHz
1.5/1.6GHz
RESCUE CO-ORDINATION CENTER
NATIONAL AND INTERNATIONAL NETWORKS

Figure 2 : Current Inmarsat Coverage


Four Ocean Region Coverage
AOR satellites at 15 and 55 degrs W

Standard-C (Class 2 MESs) and SAFETYNET EGC service are an integral part of the Global Maritime Distress and Safety System (GMDSS) developed by the International Maritime Organization (IMO) to be implemented between 1992-1999. The Coordination Committee for Telecommunications by Satellite (CCTS) of the Conférence

Européenne des Postes et Télécommunications (CEPT) has already declared Inmarsat's Standard-C as the preferred technology to provide land-mobile satellite service (LMSS) data communications in Europe.

6. NETWORK COORDINATION STATION (NCS)

In each of the present three satellite ocean regions, an NCS manages central resources like traffic channels where demand-assigned operation is used, together with signalling and traffic control. The NCS also maintains a database on the state of each commissioned MES including an indication whether or not a particular MES is currently engaged in message transfer with an LES. Statistics concerning every processed call are transmitted by LESs to the NCS. This and other data held by the NCS is used by Inmarsat for network monitoring and management purposes.

7. LAND EARTH STATIONS (LES)

Each LES serves as a gateway between the terrestrial network and the Inmarsat Standard-C communications system. The types of interface provided at the LES are decided by the earth station operator, however, telex and EGC message processing (a message broadcasting facility) are mandatory. All MESs that are active in the network region are required to register with the NCS and a copy of the list of all registered MESs is held at each LES and used as the basis for accepting or rejecting calls originating from the terrestrial network. In addition the location of every registered MES is held at the LES so that calls received at the LES for a MES in another ocean region may be redirected and the call not lost. LESs may operate their traffic channels in a demand assigned mode.

8. STANDARD-C MESs

The MES comprises a Data Circuit Terminating Equipment (DCE) which provides the interface to the satellite network and a Data Terminal Equipment (DTE) such as a personal computer or intelligent black box which provides the user or custom interface to peripheral equipment such as remote monitoring and control systems or position location device. For mobile-to-base message transfer the data is formatted in the DTE and then transferred to the DCE for transmission. In the base-to-mobile direction the DCE receives the complete message from the radio channel before passing it to the DTE for display or control etc. When idle, the MES tunes to and receives the signalling and broadcasting channel (the TDM channel) transmitted by the NCS.

The MES can be designed and manufactured by any company. However, before equipment is permitted to operate through the satellite it must first be Type Approved by Inmarsat to ensure that it conforms to the system specifications set out in the Standard-C System Definition Manual (SDM) which is available from Inmarsat. No licensing or royalty fees are payable and manufacturers each compete to sell systems, thereby ensuring a highly competitive free market environment.

Standard-C MESs are easy to install and since it has low power requirements, operation from a normal automotive battery supply is feasible.

9. COMMERCIAL CONSIDERATIONS

We are used to watching new technologies, seeing their markets broaden with the discovery of new applications and then seeing the technology itself respond by adapting to further ideas for still more applications. As providers of communications services, at the frontline of satellite technology, we know that success of our service depends on providing users with powerful tools which can then be developed and adapted to suit customized requirements.

To this end, the concept of Standard-C is itself a communication system, and Inmarsat has built adaptability into the system design. The variety of applications for Standard-C is limited only by the users' imagination and the broad technical parameters.

As a simple, inherently adaptable, cheap and mobile communications tool, Standard-C will be used widely in developing economies, not as an adjunct to that development, but as an integral part of it. In the further strengthening of a rapidly developing regional economic community, as here in the Pacific, spread so wide, among islands and continents, Standard-C could become the channel for a huge amount of the region's commercial, administrative and remote mobile communications traffic, particularly in remote regions not easily touched by economic development.

10. MARKETS

Throughout the world Standard-C will be used extensively in both the land mobile and maritime environments. Although it is impossible to anticipate all the uses, it is hoped that some examples will stimulate users imagination to put the Standard-C system to greater utility.

11. LAND BASED ASPECTS

The various market segments where Standard-C is expected to find most of its applications can be classified in four broad categories:

1 mobile users, such as railways, trucking and law enforcement agencies who would use mobile satcoms while moving;

2 frequently moving users, like survey parties, road construction projects etc, moving from one place to another;

3 fixed users, such as remote monitoring applications, for instance meteorological or in river management, or anyone working in areas where no other cost-effective means of communication exists;

4 for emergencies.

These same users can be classified in another way - those whose communications would pass on from the Standard-C system into the public networks and those who would form a closed user-group, as would be the case with railways, construction companies, flood monitoring, law enforcement, etc. Some closed groups could also access the public networks at other times.

Specific industries and services where Standard-C will prove useful, if not essential, are the trucking industry, railways, inland water transport, geological surveys, mining, forestry, irrigation, news agencies, mountaineering, health services, public administration and communications back-up for remote communities.

12. MARITIME ASPECTS

In terms of gross tonnes, the countries of the Pacific region own about one third of the world's shipping. At present 27% of all mobile earth stations (MESs) are installed on Pacific vessels. These MESs (SESs) contribute about one fifth of Inmarsat's revenues.

Many countries in the region have very large fleets of small vessels, the classic examples of course being Japan, China, Indonesia and the Philippines. These fleets are numbered in the thousands, mostly fishing boats, ferries and coastal traders. At present communications for smaller vessels are usually based on older technology requiring replacement and improvement, and can be unreliable or even non-existent. A typical example would be the shipowner with an unlicensed, illegal HF radio set on the desk in his office, which he uses to communicate with ships he often can't reach, if only because of tropical storms.

Satcoms, and Standard-C in particular, is, on the other hand, an affordable, effective and reliable way of communicating with all vessels, broadcasting safety information to groups of vessels in an area or for commercial communications between ships and owners.

Inmarsat is more and more active in studies for major national and international satcoms systems in conjunction with governments, aimed at addressing these huge domestic markets.

From a general point of view these studies presume that the purpose for any maritime communications system must be:

1 Security and safety of life at sea
2 Security and safety of shipping
3 Commercial communications purposes
4 Public correspondence

And to reach those objectives that system must surely:

1 Be highly reliable and widely available
2 Cover sufficiently wide areas
3 Be simple to use, may be automated
4 Economically justifiable.

Satcoms is proving to be the natural choice. As the number of users increase, the cost of terminals will decline thus improving the attractiveness of the system further.

Maritime distress and safety communications have relied primarily on the capability of a ship in distress to alert another ship in the vicinity. Equipments meeting existing regulations have many limitation and disadvantages such as short range (100 to 150 nautical miles for MF radio), manual distress alerting and aural watchkeeping. Noting the major technological advances, Member Governments of IMO have decided to develop a new distress and safety system which will rely heavily on automation and will use Inmarsat's satellites for rapid and reliable communications. The new regulations will come into effect over the period 1992-1999. This development will no doubt give additional impetus to the fitting of Standard-C SESs in the maritime environment.

IMO has developed GMDSS to replace the present maritime distress and safety system. GMDSS has been included in new amendments to the SOLAS (Safety of Life at Sea) Convention and will come into force on 1 February 1992.

13. MARKET SIZE

Inmarsat has carried out market research for the potential demand for Standard-C. The initial forecasts were based on four market segments only, namely, commercial vehicles, professional travellers, railways and the maritime community. These are only a subset of the likely range of user markets and applications. Even so, for the Pacific region, results indicate a potential market of some 124,000 users by late 1990's. With the identification of more applications, the eventual number of users will probably be much greater.

The present forecast for total Standard-C MES demand for the world by year 2000 is some 500,000 and a significant percentage is expected to be in the Pacific region. An enticing market of well over US$1 billion in equipment sales is projected.

14. USER INPUTS

Numerous market opportunities exist in the Pacific and while applications can be readily identified, one needs to assess the commercial aspects of particular ideas carefully. The timeliness of introducing new technologies and the development of cost-effective user applications are as fundamental to their success as is adequate research into their financial viability in the markets for which they have been planned. It is essential that users are ready for them and that the operations, of which they will form a part, will be able to bear their costs profitably. To this end a methodical assessment of market niches is vital to all our futures, as service providers, manufacturers or agents.

The myriad possibilities for Standard-C are mostly rooted in the following areas, all of which only thrive with the cooperation between Inmarsat, manufacturers and software companies working on a co-operative basis.

Inmarsat has long learned the importance of listening to customer needs and has made some important investment decisions based on such inputs. Inmarsat has adopted the policy to move to digital terminal standards, e.g. Standard-C and Standard-B, the digital successor to the very successful Standard-A. The decision to move to four ocean regions will improve coverage and service quality for users in some regions. Before the second generation satellites are in operation, Inmarsat has already released a request for proposal for the third generation satellites, trying to bring in newer technology into the space segment so that lower charges could flow earlier to end users. All the above decisions have benefited from inputs from users.

In 1990 Standard-C will move from pre-operational trials into full global operational coverage. Although it is certain that initial uses will be telex and EGC based, the further developments will depend significantly on user identified needs.

Inmarsat has been working with Signatories to further develop Standard-C applications. In fact, a seminar in Beijing, China in May 1990 will demonstrate some of the equipment available and applications which are identified by users as being of immediate use. Inmarsat will be embarking in a traffic forecasting exercise in May 1990 and to ensure that realistic forecasts are included for optimized investment decisions and to encourage further application expansions, inputs from all interested in the system are invited.

We are on the brink of a revolution in communications - you are invited to participate and thus encourage the further strong growth in the Pacific region.

Session 4.4

Networks II

NOTES

A GUIDE TO IMPLEMENTING DAMA NETWORKS

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1. ABSTRACT

Demand Assignment Multiple Access technology is an ideal solution for servicing thin route telephony applications. This paper provides a discussion on the efficiencies of DAMA and outlines issues which Telecommunications Authorities have to consider in planning the implementation of a DAMA network.

2. INTRODUCTION

Demand Assignment Multiple Access is a satellite access method which maximises use of costly space segment resources by the shared use of available capacity through allocation of channels between users on a call by call basis.

The characteristics of satellite communications in combination with the technique of DAMA makes this system an ideal implementation for thin route or low capacity applications.

While the concept of DAMA itself is relatively simple, its implementation in non homogenous networks ie networks comprising multiple signalling schemes, assorted terminal equipment types and earth stations of various antenna sizes is more complex.

Drawing upon experience gained in the design and development of the proposed Pacific Area Cooperative Telecommunications (PACT) Network, this paper will discuss a DAMA implementation based on Intelsat's Vista Single Channel Per Carrier Service and focus on the issues Telecommunications Authorities will have to consider in establishing a DAMA Network.

3. BACKGROUND

Demand Assignment, or sometimes called call interpolation, falls into three categories: variable source, variable destination and fully variable modes of operation, with each description using the transmission medium as the reference.

The first two modes are very similar, with the source or destination being the variable component ie destination and source are fixed respectively. For the fully variable mode, however, both the source and the destination may be varied independently.

Although Demand Assignment technology has been around for a quite a few years it has not received wide acceptance as evidenced by the limited number of operational networks in the world today. The Indonesian domestic DAMA network is currently one of the largest networks with over 100 stations in service. The proposed PACT Network is more complex and expected to overtake the Indonesian network in terms of network size and capability.

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4. DEFINING THE APPLICATION FOR DAMA

The Demand Assignment Multiple Access technique, as the name implies, provides for the dynamic allocation of circuits from a common pool on request during call setup and the potential for making multi-parallel connections between any two stations within the geographical coverage area of the satellite. The realisation of the latter capability is commonly referred to as full mesh connectivity.

The concept of DAMA is nothing more than applying the well recognised traffic engineering method of maximising utilisation efficiency of circuit capacity by the concentration of traffic carried on low capacity routes into a large trunk group in a satellite environment.

What DAMA offers is a networking solution for applications which are expected to generate only a modest volume of traffic per route. While low route traffic is the criterion which establishes whether the particular application is suitable for DAMA, once a service is introduced on DAMA, unforeseen growth in traffic levels on certain routes could be accomodated by introducing Permanently Assigned Multiple Access (PAMA) circuits and allowing peak traffic to overflow onto DAMA capacity. Such an application is based on another well understood traffic engineering principle that last choice circuits in a given trunk group carry only very low traffic. An illustration of this is provided in the example under Network Dimensioning.

As will be shown later in this paper, DAMA is only suitable for networks in which traffic density per route is low, with projections typically, up to around the one erlang mark. Efficiencies will be achieved for networks operating in partially or fully variable mode topology with the latter mode being more efficient from the point of view of the space segment channelling requirements and savings in terminal hardware costs.

5. NETWORK DIMENSIONING

The design of any network requires the proper dimensioning of each route and the network as a whole. The cases considered here will include existing direct routes as well as new routes.

For existing routes, a study should be made of the traffic profile to determine the overflow traffic and the traffic carrying capacity of the circuits. An example of such a study [1] resulted in the following:

Percentage of Traffic	Percentage of Circuits
90.0	66.0
91.0	67.5
92.0	69.5
93.0	71.0
94.0	73.5
95.0	75.7
96.0	78.3
97.0	81.2
98.0	85.0
99.0	90.2
99.8	100.0

As can be seen, the last few circuits carry but the barest amount of traffic, catering only for peak loads during the busy hour to provide the designed grade of service. It is highly inefficient utilisation of circuit capacity and thus, this traffic is best carried using DAMA. What needs to be assessed is the number of circuits that is worthwhile diverting to a DAMA network and this consideration requires an economic appraisal taking into account such factors as hardware and bearer channel costs and any applicable tariffs for use of DAMA capacity.

For new routes, terminal equipment always invariably involve the connection of some kind of switching facility, with a PABX being the most likely type in remote locations because of its lower cost, versatility and ability to also serve as a local switch. A typical arrangement is illustrated in Figure 1.

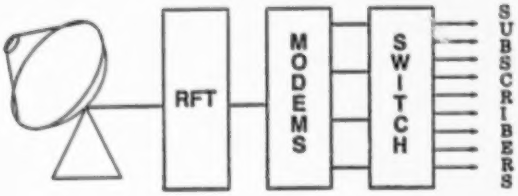


FIGURE 1

For this particular case, two types of traffic are involved: local traffic which is routed through the switch between subscribers and the other being transit traffic for carriage via a DAMA network. It is not an easy task to forecast traffic levels for a new service as economic factors, population densities and other related issues have to be considered.

However, as a rule of thumb, subscriber traffic may be assumed to be between 0.004E to 0.006E per subscriber with between 10-15 percent of this traffic being transitory in nature. The figures quoted are based on experience gained in measured performances of land-based networks of similar environment to the Pacific Islands and in the context in which they will be used can be regarded to provide a good first approximation for assessing route and network traffic in the absence of actual raw data.

For partially variable DAMA, the cumulative traffic per node could then be used for determining the number of DAMA circuits required for supporting each node by referencing Erlang Tables[2] under the appropriate grade of service performance column. Similarly for fully variable DAMA, the total network traffic, derived by summing the traffic for each node, can be used to estimate the total number of satellite circuits.

6. PHYSICAL CONNECTIONS

In order to appreciate the implications of physical connections to a DAMA network, it should be stated that DAMA is a transit switch. Unlike a telephone exchange which allocates physical crosspoints, it assigns satellite channels.

Of major importance in the planning of a DAMA Network is the definition of the signalling protocol(s), the numbering plan and the physical interfaces to the DAMA channelling equipment at the earth station. In a domestic network where only one signalling type and a uniform numbering plan is involved, a DAMA implementation is straight forward but in a mixed type of environment as in the case for the PACT Network, such an implementation is far more complex, particularly since mesh connectivity is a requirement.

A signalling protocol defines a rigid set of rules which must be adhered to for successful call establishment and completion and, hence, in an environment involving more than one type of signalling, conversion from one type of signalling to the next is not always possible because of differences between the applicable rules. The signalling schemes contemplated therefore need to be examined closely for compatibility and also loss of functionality. An example where such differences occur is between CCITT R2 and CCITT #5; backward signalling used by R2 to request transmission of part or all of the dialled digits is not supported by CCITT #5 and, as such, this feature of the R2 signalling will be lost when an attempt is made to convert between these two types of signalling. In cases where decadic E&M is planned, conversion between this signalling type to #5 will not result in any impairment in performance except for marginal degradation in post dialling delay.

For networks in planning, if a particular signalling scheme is not already in use, preference should be given to a type which has faster call handling to ensure circuit occupancy during call setup and associated common equipment holding time is kept to a minimum.

The numbering plan is another important design consideration as it defines the digit analysis and any digit reconstruction rules that will have to be applied to route a call to its correct destination.

In a multiple user network, numbering plans comprising varying digit lengths are common and should direct connections of payphones be required, different long distance access codes will also have to be accomodated in the call processing design.

An earlier view [3] that access codes will be required to resolve ambiguity in situations of countries with identical numbering can be overcomed by listing numbers in country specific numbering analysis tables which identifies whether a call is local or otherwise.

By allowing use of payphones in the network, the DAMA system will be required to perform call routing normally handled by a lower order class switch to identify a particular subscriber line as well as support for the appropriate line signalling conditions.

Likewise for PABXs, the DAMA system will need to determine the line signals to send and through defined digit reconstruction rules, the digit sequence to forward to the PABX for routing of the call.

The type of physical connections to a DAMA network will greatly influence the complexity of the DAMA design and careful planning is recommended to control the range and manufacture of equipment.

7. DISTRIBUTED VS CENTRALISED DAMA

The DAMA systems that are promoted by various vendors are either distributed or centralised, with the choice of each type dependent largely on cost or performance.

The capabilities of a centralised DAMA system are far superior from a network management and call handling perspective because the supervisory and control signals are processed by the hub computing system and this is reflected in its much higher cost.

In assessing which of these systems is more suitable, requirements for call accounting, signalling conversion, network management (real time and planning) and network testing capabilities must be defined. Where these are viewed as important elements, then a centralised DAMA system is the way to go.

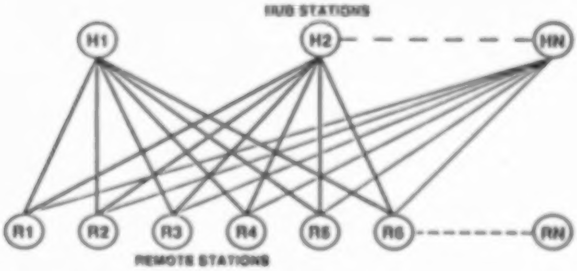
Distributed DAMA systems generally offers much lower hub station cost and higher remote station cost whereas for centralised DAMA, the converse applies. If cost is of primary concern, it may be necessary to fully cost the remote stations and compare this figure against the DAMA Hub cost.

A centralised DAMA system unlike the distributed DAMA design is vulnerable to total network failure due to equipment outages of key components at the Hub, but this situation can be countered by providing DAMA system controller and common equipment redundancy and in certain cases by also having diversity.

8. ECONOMICS OF DAMA

A discussion on the economics of a DAMA network follows from earlier topics. It is not intended that this subject be comprehensive as this is beyond the scope of such a paper. However, sufficient information will be covered to allow a closer examination by network designers.

To illustrate the efficiencies of DAMA, two network models; that of a multiple-star-mesh (also referred to as radial type of network) and full mesh topology as depicted in Figures 2 and 3 will be used as representative examples. The former topology can be associated with that for the PACT Network. The relevant equations for assessing the number of links are also included under their respective figures.



$$N_T = N_H \times N_R$$

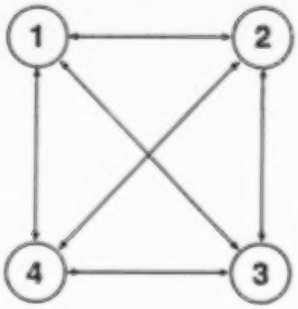
Where:

N_T = Total number of links for the network;

N_H = Number of hub stations accessed;

N_R = Number of remote earth stations;

FIGURE 2



$$N_T = N(N-1)/2$$

Where:

N_T = Total number of links in the network;

N = Number of stations planned.

FIGURE 3

Efficiencies of DAMA or the DAMA advantage (also DAMA gain) can be expressed in terms of a ratio of PAMA to DAMA circuits, calculated as in the following example:

Assumptions used:

a) Each route carries a maximum traffic level of 0.28E;
b) A 3 percent grade of service is the design objective;
c) Total number of stations in the network is 50.

Total network traffic
$= N(N-1)/2 \times 0.28$
$= 343.0$ E
Total PAMA circuits required
$= N(N-1)/2 \times 2$
$= 2450$
DAMA capacity required
$= 350$
DAMA advantage
$= 7.0$

A graphical presentation of the efficiencies of DAMA over PAMA for each of the multiple-star-mesh and full mesh cases are at Figures 4 and 5 respectively.

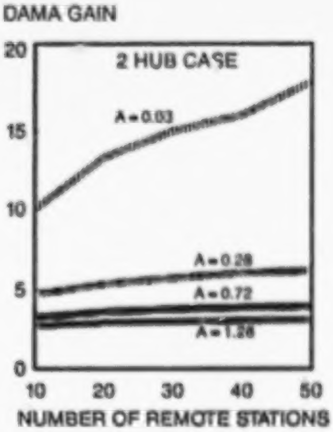


FIGURE 4

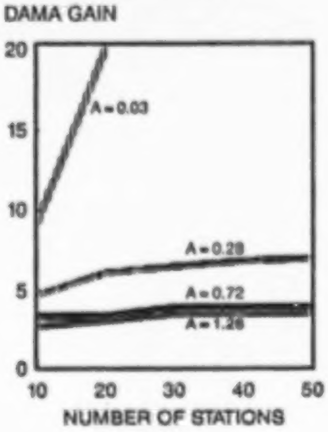


FIGURE 5

It should be mentioned that in practice, not every route will need to be serviced and the actual DAMA gain may turn out to be slightly lower than theoretical projections.

In addition to savings in space segment charges, hardware requirements may also be reduced eg lower HPA size, modems, reflecting further cost savings.

For administrations already planning networks using SCPC, it is worth noting that the incremental cost of a remote DAMA terminal is of the order of US$15K and hence is not a major issue.

9. OPERATING AND MANAGING A DAMA NETWORK

The continuing rise in manpower costs has forced telecommunications administrations to pay more attention to support facilities and tools which makes network operations an effective and efficient process, with attendant benefits of minimising staffing requirements and as a consequence recurrent costs.

Apart from manpower resources that are required for operating, managing and maintaining a DAMA network, it must be equipped with tools that allows day-to-day operations to be performed and collection of traffic statistics for medium to long term planning of the network.

In a dynamic network such as DAMA where events are changing from moment to moment, it is essential that call handling data and status reports be captured for real time display of key network operational performance and on a storage medium for later off-line processing to verify performance of the network eg grade of service is within design parameters and to provide the ability to identify congestion problems and causes arising from equipment failures and inadequate provisioning resulting from either dimensioning or growth. And where customer billing is required, analysis of call records on a periodic basis will also have to be carried out to determine usage and charges.

For a growing network, an important element is inbuilt flexibility of the operating system to allow reconfiguration of the network, addition/deletion of a facility and changes to the database.

With a network potentially comprising a significant number of earth stations, modems and satellite channels, it would be near impossible to have testing performed other than by an automatic means. Such a capability must be provided to facilitate testing of EIRP level, carrier frequency and baseband signal to noise in a loopback mode.

The effective operation of the network requires that test calls be made from time to time to service customer complaints. Such a requirement dictates the provision of an exchange simulation facility which allows the making of test calls using the appropriate signalling scheme from a network operations centre into the DAMA network to assess the nature of the problem and for receiving calls from remote centres in need of assistance.

No matter how secure a network may appear, it is prudent to develop contingency plans for network restoration in the event of a catastrophic failure of DAMA control centre. A fallback position will be through transition from DAMA to PAMA with a nominated centre for coordination of restoration.

10. DESIRABLE FEATURES

The features of a DAMA system that are considered highly desirable are described below.

EIRP Control

In a network which comprises earth stations of varying sizes and dispersed geographical locations relative to the satellite beam pattern, a means of controlling the carrier EIRP, having regard to the receiving station G/T performance will allow the satellite power resource to be used to its maximum capacity.

Bandwidth Pool

For multi-user networks, it would be desirable to have a capability of controlling the number of circuits a user may occupy at any one time in an arrangement termed "bandwidth pool" so as to ensure available capacity is not all consumed by the one user.

Semi-Permanent Connections

With satellite capacity assigned at random, there needs to be a network management capability which allows by operator command the ability to connect any two channels for test through a feature referred to as "semi-permanent connection".

11. CONCLUSION

Issues which Telcommunications Authorities have to consider in planning the implementation of DAMA networks have been described in this Paper. Skills in Networking, Switching and Transmission engineering and Project Management are necessary pre-requisites to bringing any DAMA implementation to a successful conclusion.

DAMA offers efficiencies not only in space segment capacity but also significant savings in earth station hardware through lower dimensioning requirements.

12. ACKNOWLEDGEMENTS

The author would like to thank OTC for permission to publish this paper, OTC International for sponsoring visit to PTC '90 and Messrs Y Cheong and A Michie for reviewing the switching aspects and DAMA System functionality respectively.

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Lessons Learned in Systems Integration of Large-scale Telecommunications Networks

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1. Abstract

This paper will help its readers to:

1. Understand why systems integration is necessary to create large telecommunications networks
2. Avoid and solve problems commonly encountered during systems integration of large telecommunications networks
3. Plan, manage, and execute the activities leading to the successful implementation of large telecommunications networks

2. Project history

The initial motivation for the INdiana TELEcommunications NETwork was born in 1983 when the Indiana Higher Education Telecommunication System (IHETS) formulated its "1990 Plan" for a significant upgrade to its analog microwave network that supported its Instructional Television Fixed Service (ITFS) broadcast video network. Realizing that it would be unlikely to get legislative approval for the capital investment necessary to construct this upgrade, IHETS enlisted the political support of Lieutenant Governor John M. Mutz who chaired a committee which recommended the creation of INTELENET. As a result, Governor Robert Orr established a steering committee and task force in early 1985 to examine Indiana's present and future communications requirements for government and education and to determine the feasibility of a consolidated statewide network. After six months of study, this group concluded that such a statewide network was indeed technically feasible and economically justified. In early 1986, the Indiana General Assembly enacted a statute that created the INTELENET Commission to govern INTELENET.

The INTELENET request for proposal was released in March 1986. Proposals were received in June and the contractor was selected in October. February 6, 1987 was a significant milestone as the INTELENET Commission and GTE Telecom, Inc. (GTETI) signed a contract. Network cutover was begun in March 1988 only one year after construction was initiated!

3. Defining requirements and feasibility study

3.1 Procedure

The first steps toward INTELENET had the following purposes:

1. To collect and analyze data in enough detail to accurately compare communication capabilities and cost of INTELENET to those of existing systems

2. To provide traffic data necessary to estimate the cost of INTELENET

3. To provide requirements data for the procurement process.

The investigation was conducted by surveying potential INTELENET users, interviewing key users, and collecting feedback from representatives of user communities. The process revealed that there was substantial unsatisfied demand for telecommunications services, especially in higher education, but also in other levels of education and among local governments.

The feasibility analysis explored two areas:

1. Technical feasibility of INTELENET

2. Possible range of costs that Indiana would incur depending on which implementation option was selected.

Regarding technical feasibility, it was concluded that INTELENET was technically feasible.

3.2 Scenarios

As a result, several scenarios were offered in the feasibility report:

1. Current video, voice, and data requirements

2. Option 1 (above) plus additional video channels

3. Option 2 (above) plus 10% annual growth

3.3 Products

The following is a brief table of contents of INTELENET's Feasibility Assessment Report:

1.0 Introduction
1.1 Objectives
1.2 Scope
1.3 Methodology

2.0 Requirements Assessment
2.1 Overview
2.2 Objectives and scope

2.3 Analysis and results
    2.3.1 Methodology
    2.3.2 Existing Networks
    2.3.3 Desired applications
    2.3.4 Requirements database
2.4 Conclusions and recommendations
    2.4.1 Phasing strategy
    2.4.2 Services required from INTELENET

3.0 Feasibility Assessment
3.1 Overview
    3.1.1 Objectives
    3.1.2 Scope
    3.1.3 Methodology
3.2 Conceptual design
    3.2.1 Purpose
    3.2.2 Approach
    3.2.3 Description of the conceptual design
3.3 Summary of current telecommunications cost for Indiana
3.4 Scenarios for INTELENET
    3.4.1 Descriptions of feasibility scenarios
3.5 Analysis of INTELENET Scenarios
    3.5.1 Technical factors-Provision of required features and capabilities
    3.5.2 Management factors
    3.5.3 Cost factors
3.6 Other opportunities
    3.6.1 Cost saving opportunities for network access
    3.6.2 Concentration of long distance facilities
    3.6.3 Use of intelligent network services
3.7 Conclusions and Recommendations
    3.7.1 Feasibility of INTELENET services to be provided
    3.7.2 Availability of transmission facilities and services
    3.7.3 Cost savings
    3.7.4 Recommended actions
    3.7.5 Recommended implementation strategy
    3.7.6 Recommended procurement strategy
    3.7.7 Recommended actions

Appendix A: Phase 1 INTELENET Communications Requirements Traffic Matrix
Appendix B: Phase 1 and 2 Cumulative Communication Requirements Traffic Matrix
Appendix C: Phase 1, 2, and 3 Cumulative Communication Requirements Traffic Matrix
Appendix D: Cost Summaries for INTELENET Feasibility Scenarios

3.4 Lessons learned

Although the aggregate cost of new services will likely be less than existing services, there will develop individual situations where circumstances may cause new services to be more expensive. In addition to aggregate cost data, the cost of individual existing circuits should be cataloged. Then, creative solutions to pricing these new services may be possible with the extra time created by early identification of these unusual situations. For example, unswitched data services replaced by INTELENET sometimes cost less than the subsequent INTELENET replacement because the topology of INTELENET resulted in all facilities, both switched and unswitched, being routed through the network control center in Indianapolis. Therefore, INTELENET's cost for an unswitched data service between cities other than Indianapolis was artificially high as a result of its unnecessary routing through Indianapolis!

Access is another troublesome issue for a backbone interexchange network such as INTELENET. Especially, local exchange carriers interpreted that INTELENET is an interexchange carrier and hence, imposed access tariffs for local access facilities that supported the statewide voice network! Previously, the network was not subject to access tariffs.

In conclusion, the feasibility analysis must pay close attention to understanding which regulations and tariffs were in force in the present network and the impact of any new architecture on subsequent costs and regulatory activities!

4. Procurement

The steps in the procurement process included:

1. Preparing a request for proposal (RFP)
2. Evaluating the proposals
3. Selecting the contractor

4.1 Systems integration

Systems integration creates a crucial partnership between contractor and customer motivating the contractor to "do it all" for the customer by giving the contractor complete authority for project management. The contractor must be committed to providing a broad range of services and the customer must be committed to requiring a similarly broad range of services to justify the substantial effort of systems integration.

4.2 Preparing a request for proposal

Information included in the RFP included:

1. Switching hub location(s)
2. Concentration site locations
3. Voice, data, and video channel requirements at each site
4. Interfaces to be supported
5. Performance and availability requirements
6. Network management requirements
7. Contractual obligations.

4.3 Evaluating the proposals

Evaluating the proposals should be based on the following factors:

1. Technical specifications
2. Quality of proposed approach
    a. Soundness of technical approach
    b. Implementation planning
    c. Vendor qualifications
3. Price

4.4 Selecting the contractor

Selecting the contractor depends on the relative weight assigned to the above factors. The greatest significance should be assigned to the quality of proposed approach because execution, rather than technical design, will distinguish a successful contractor. Although important, price is relatively least significant because a lower price offers no advantage if the accompanying solution does not fulfill requirements and if the contractor is unable to fulfill his promises.

4.5 Lessons learned

In preparing the RFP, it is crucial to provide complete specification, especially for custom software components of the network that are not specified by industry standards. Furthermore, contract terms should provide substantial flexibility to deal with unforeseen problems that will inevitably arise in a large and complex project.

5.0 Implementation

Implementation requires the following to insure success in scheduling, budgeting, and operations:

1. Detailed planning that is reviewed and updated weekly
2. Detailed scheduling of resources that is reviewed and updated at least weekly and in the initial stages, on a daily basis
3. Detailed coordination of construction, procurement, installation, test, and cutover
4. Regular and patient communication between the contractor and the customer to identify and to resolve problems as a team
5. Weekly meetings to check status toward network conversion
6. Weekly meetings to plan and to execute network cutover
7. Strict budgeting and accounting of manpower, time, and financial resources
8. Constant review of budget versus requirements.

5.1 Design and vendor selection

To deal with the size and complexity of INTELENET, it was divided into several subsystems:

1. Fiber optic transmission system
2. Video transmission and switching
3. Voice and data transmission and switching

5.2 Project planning and scheduling

Since the network included sixteen concentration sites that covered an entire state, the sites were divided into three clusters with a staggered implementation schedule.

Furthermore, the project was organized into the following subsets:

1. Land and buildings
2. Digital voice/data switch
3. Carrier equipment in 3 types of locations:
    a. Network control center containing:
        Fiber optic transmission system
        Voice/data: digital cross-connect and T-1 multiplexers
        Video: DS-3 cross-connect and codecs
        Alarms
    b. Regenerators
    c. Concentration sites containing:
        Fiber optic terminals
        T-1 multiplexers
        Video codecs
        Remote alarms
4. Outside plant

The following milestones were specified for each of these projects:

1. Engineering start: project engineering begins
2. Work order approval: project engineering completed
3. Material ship: material associated with work order shipped by manufacturer
4. Construction start: installation or construction begins
5. Test ready: major components installed and testing ready to start
6. Construction complete: all installation activity completed
7. In-service: equipment placed in-service to handle traffic

5.3 Acceptance testing

An acceptance test plan was defined and performed to do the following:

5.3.1 Catastrophe testing

1. Determine the "most likely" causes of failure
2. Test network operation by simulating failure and evaluating reaction
3. Take whatever action necessary to protect INTELENET from damage that could cause frequent service interruption

5.3.2 Individual equipment and component interoperability testing

In addition to testing individual pieces of equipment, the effect of individual component failures on **other** portions of network operation should not be overlooked. These tests will also help to determine the requirements for maintaining equipment spares.

5.3.3 Network control center acceptance

Network control center (NCC) acceptance tests the following levels of network monitoring:

1. Sub-component level diagnostics
2. Component level diagnostics
3. System level checks

Especially, the following activities were tested:

1. Fault detection and recovery at either the NCC or a concentration site
2. Network diagnostics, e.g. bit error rate tests
3. Trouble logging

Detecting and handling outages of tail circuits (beyond the network backbone) that interrupted a user's access to INTELENET is one of the most difficult, but important, tasks of the NCC.

5.3.4 Network loading

Both normal and abnormal situations should be tested to simulate unusual circumstances. For example, load boxes should be connected at various points to simulate traffic.

5.3.5 Compatibility testing

Compatibility testing should determine that network signaling systems, interfaces, and applications adhere to recognized standards. Furthermore, a list of all pieces of equipment and related interfaces should be compiled with specification of the standards to which they conform.

6. Cutover

Cutover was coordinated by a committee that included representatives of the contractor, customer, and incumbent carrier to insure a smooth transition.

7. General lessons learned

Contract management by the customer is the most crucial responsibility of the customer who struggles to maintain an amiable partnership with the contractor while protecting his rights as a customer under the terms of the contract.

Software requirements were the most difficult to define and to fulfill. For example, the broadcast video switching custom application required by the network's largest customer suffered from incomplete and unstable specification. Network management software suffered from lack of commitment to sound software engineering principles.

Often, both customer and contractor personnel involved in implementation may be different from those involved in procurement. This situation should be avoided in order to maintain a continuous and consistent effort throughout the project with a strong sense of responsibility for all aspects of the project.

Communication between customer and contractor is the most critical success factor. Faithful documentation of project activities is the most important communications tool.

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Network Management of Large-Scale Networks
— Outline and Advantages of Private Packet Network Systems and Concentrated Management—

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Abstract

Recently, information systems have become one of the most crucial topics for Japanese corporations, many of whom are trying to build their own infrastructures. As the networks of these infrastructures cover an ever wider area and become increasingly powerful and complicated, many problems arise, especially in the area of operation management.
This paper discusses how such problems have been solved by the CABIN Network System and also explains the effectiveness of this system.

1. INTRODUCTION

In April 1988, as part of its complete reorganization, JAPAN TOBACCO INC. built a large-scale on-line network throughout the country to improve the efficiency of its administrative departments, called the "CABIN Network System".

This network system was planned and designed to meet the following requirements:

1) Creation of an infrastructure
This network system should provide a communications system base.
2) Creation of an integrated network system
The network system should handle multi-media communications.
3) Control of the schedule for developing the system
A large variety of development work should be completed within the deadline.
4) Flexibility in system design
Flexibility is needed in system design since infrastructure design and system development proceed in a parallel manner.

2. THE CABIN NETWORK SYSTEM

2.1 OVERVIEW

The main components of the CABIN Network System are the "Centralized Monitoring System" and are "Packet Switched Network", and the main features are as follows:

1) Transmission Security
The system connects lines when a fault occurs at a line or a node, using automatic bypassing in packet switching by combining the high speed digital line with DDX-C (NTT public digital data switched network). Furthermore, it ensures security by automatically bypassing line connections during transmission peaks.
2) Expandability and flexibility
The centralized operation management allows configuration changes such as system expansion or addition of terminals, to be made without affecting or interrupting the network.
3) Uniformity
Provides a uniform communication service to end-users through the use of a simple hierarchical structure in which the key networks and branch networks are combined.
4) Reliability
Ensures system reliability through the use of a centralized monitoring system which immediately informs the carrier or manufacturer of the location of a failure, and also provides information to all end-users while a failure is being dealt with.
5) Cost performance
Enables improvement of line efficiency, reduction of the CCP (Communication Control Processor) of the central host computer through the use of multi packet communication, and transmission at peak traffic through the use of bypassing.
6) Usability
Improves efficiency of operation management as follows:
- improves efficiency of operation activities by implementing centralized monitoring with fewer personnel.
- improves efficiency of design work by overall management.

Also provides quick recovery from failures and reduces the amount of overall activities by reducing the amount of coordination works required for recovery from failures.

2.2 OUTLINE OF THE SYSTEM

The CABIN Network System is the largest private packet switched network in Japan. In this system, the packet switching devices and the multiplexers are distributed at 21 key points, and each point is connected to an NTT high speed digital line. (192Kbps to 6Mbps) (Reference to Figure 1)

The basic topology of the network is a hierarchical tree structure designed to facilitate expansion or changes to the system. The relay is divided into three levels in consideration of the delay caused by packet switching, and the level connecting the center and the regional centers has a mesh structure, using an NTT DDX-C line as a backup line. This structure provides high reliability over the network as a whole, as well as expandability, flexibility, and better cost performance.

For the purpose of monitoring the network components, which are the communication devices distributed at each point (packet switching devices, multiplexers, and LAN), and lines, the centralized network monitoring system was constructed.
With this system, the stop time in the network is minimized because many faults can be located accurately and immediately when they occurs.

3. NETWORK MANAGEMENT

3.1 NETWORK CENTRALIZED MONITORING SYSTEM

The centralized monitoring system of the CABIN Network System consists of the macro monitoring system and the monitoring system for communication devices, as shown in Figure 2.

In this system, monitoring and operation of the network is carried out with each communication system installed under the control of the macro monitoring system.

The macro monitoring system collects contact information from each device. The collected information is then transmitted to the processing device via a high speed digital line. The system can also be monitorred using a public line since as a backup the monitoring system includes line and all communication devices in case the high speed digital line develops a fault.

3.2 ADVANTAGES

The advantages of introducing two Network Centralized Monitoring systems are as follows:

1) Achievement of the initial goals
The initial goals have been achieved for the five items described above (including safety). The devices also operate satisfactorily.
2) Efficiency in operation management
Improvement of efficiency in operation management since operation activities have been partially reduced by distributing the packet switching devices and related devicea at 21 points, making it possible for users to concentrate on key issues such as structural changes and trouble shooting.
3) Increase in freedom for communication and data porcessing
Since the system has a network structure <topology> consisting of the key network and the branch network, design work can be performed using the same concept when incorporating a newly developed system. Therefore, more freedom in logical design can be obtained when expanding the system by creating the modified system on the actual network. Also, users can concentrate on the improvement of communication efficiency when dealing with network changes.

3.3 PROBLEMS WITH THE NETWORK CENTRALIZED MONITORING SYSTEM

The problems with network centralized monitoring system described below still have to be solved:

1) Introduction of new technology
There are difficulties in responding to the development of new data processing systems and incorporating new communication technologies while maintaining the centralized monitoring system.
2) Personnel training
Since specialized training is given only to a few personnel, more education is required for all personnel to understand communication techniques.
3) Handling complex faults
The present monitoring device is not sufficient for specifying faults because faults which develop in the large-scale system during stable operation can have the following complexities:
   - A fault develops simultaneously at multiple devices.
   - A multiple fault develops across various devices.
4) Effectiveness of structural management
The structural management of fault management and accounting management has become more important. Therefore, the larger the system grows, the greater the number of items there is pertaining to operation and management. Efficient structural management also becomes more difficult due to repeated structural changes.
5) Inter-operability
As more and more new communication devices are produced due to advances in communication technology and current devices become more sophisticated and specialized, it is impossible to provide training for personnel that keeps up with the rate of change and system obsolescence.

4. CONCLUSION

Large network systems in Japan tend to combine ISDN and LAN-WAN connections. These hybrid network seems to be the trend in network systems. Making an efficient hybrid network was the goal of the CABIN Network System. Conventional network design attached importance to functions and cost. However, for hybrid network systems, network management must be the focus, and functions and cost must be based on management.

"Network management determines the quality of large-scale network systems."

This is the concept we have followed, build the network systems for the future.

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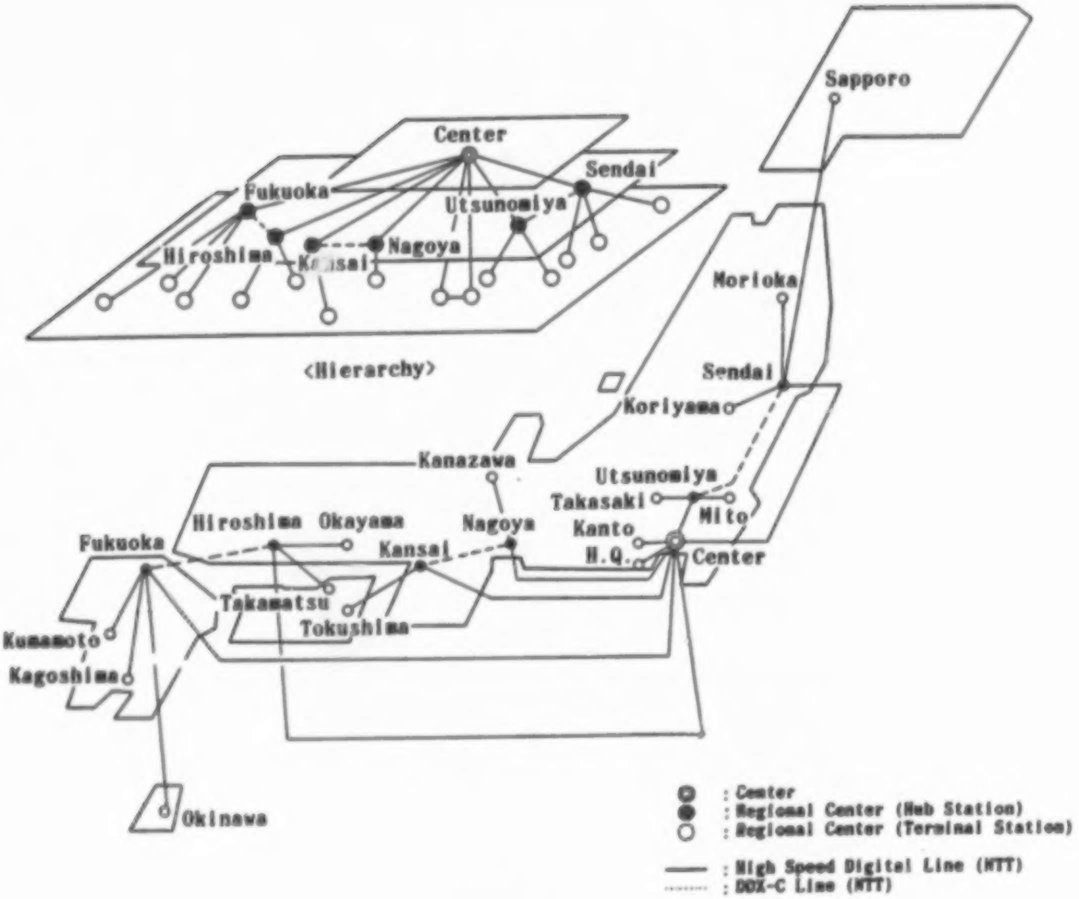
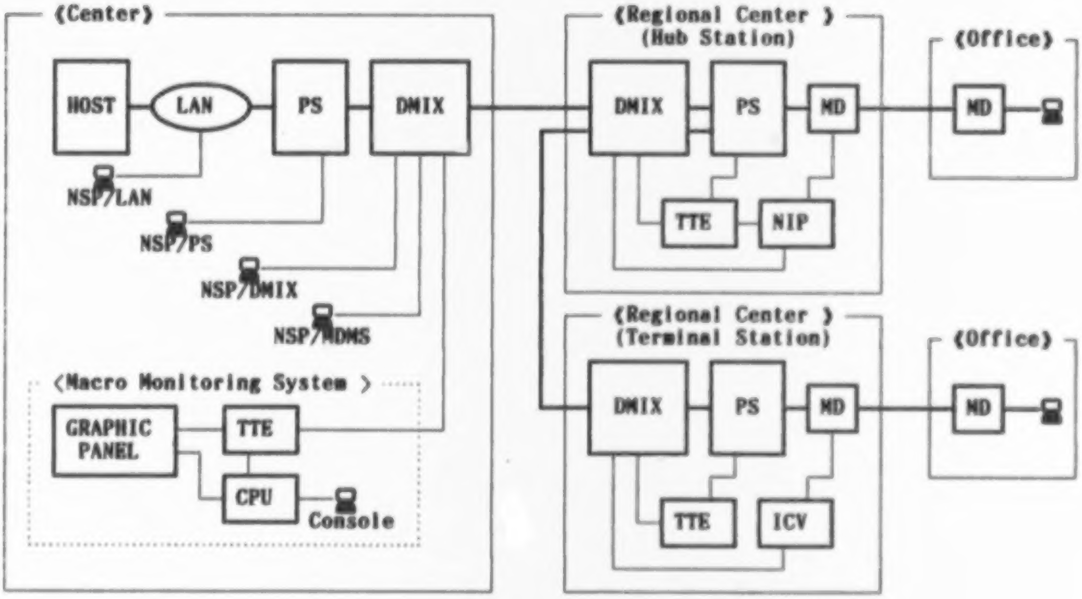

Sapporo
Center
Sendai
Fukuoka
Utsunomiya
Hiroshima
Kansai
Nagoya
<Hierarchy>
Morioka
Sendai
Koriyama
Kanazawa
Utsunomiya
Takasaki
Mito
Kanto
H.Q.
Center
Fukuoka
Hiroshima
Okayama
Nagoya
Kansai
Takamatsu
Tokushima
Kumamoto
Kagoshima
Okinawa
◎ : Center
● : Regional Center (Hub Station)
○ : Regional Center (Terminal Station)
—— : High Speed Digital Line (NTT)
······· : DDX-C Line (NTT)

Figure 1 CABIN Network System


(Center)
HOST
LAN
PS
DMIX
NSP/LAN
NSP/PS
NSP/DMIX
NSP/MDMS
<Macro Monitoring System >
GRAPHIC PANEL
TTE
CPU
Console
(Regional Center)
(Hub Station)
DMIX
PS
MD
TTE
NIP
(Office)
MD
(Regional Center)
(Terminal Station)
DMIX
PS
MD
TTE
ICV
(Office)
MD

P S : Packet Switching device (FETEX-5000series)
DMIX : Digital Multimadia Information Multiplexer (FACOM 2660)
NSP : Network Service Processor (monitor system)
LAN : FACOM 2883 (Optical LAN)
MDMS : MoDem Management System (FACOM 1960)
MD : MoDem (FACOM 1921LN)
NIP : Network Information Processor (MDMS)
ICV : Interface ConVerter (MDMS)
TTE : Transmission Terminal Equipment (Macro Monitoring System)

Figure 2 Network Centralized Monitor System

Session 4.5

National and Transnational Data Services in the Post-Broadband Era

Chair: John Krzywicki, Cambridge Strategic Management Group

Panel: Gregory Crew, Hong Kong Telephone Company
Raynold Leconte, France Telecom
Barry A. Moul, International Digital Communications

NOTES

Session 4.6

New Developments

NOTES

COMPOUND DOCUMENTS, MULTIPROCESSOR PCs, AND THE MARKETING OF VIDEOCONFERENCING

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President, Eidetic Technology, Inc.

Every futurist of the '70s who forecast a large market for videoconferencing in 1990 was wrong. With the advent of ISDN, PC-based codecs, and the CCITT H.261 (informally known as "px64") standard for digital videoconferencing, will videoconferencing catch up with expectations? The author argues that even if a PC-based codec, video, and audio kit have a Group 4 fax machine pricetag and Basic Rate service is the rule, videoconferencing may remain technology's stepchild. This scenario could be significantly altered, however, if certain business-oriented enhancements, dubbed by the author "project management support services," became available. The paper discusses a variety of such project management services, how multiprocessor microcomputers with windowed displays can be used as videoconference workstations, and how the video, audio, and work products of a videoconference can be stored and accessible as compound documents. The paper concludes that the marketing of videoconferencing equipment and services should emphasize the benefits of project management support services, desktop videoconferencing, and compound documents, and deemphasize time and travel savings.

THE MEAGER MARKET

In Stanley Kubrick's 1968 movie, "2001: A Space Odyssey," the spaceborne protagonist videoconferences with his family at home on distant Earth. This scene and the earlier debut of AT&T's Picture Phone may have inspired some of the wild projections for the size of the market for videoconference equipment and services by 1990. Of course, there is no significant home videoconferencing market. Moreover, today's business videoconferencing market is small, lacks codec standards, and requires either a major capital investment or proximity to a public videoconferencing facility. The forecasters of the '70s, and even the '80s, who foresaw a large videoconferencing market were far off the mark. Why? Digital video picture quality? Lack of codec standards? Excessive costs? Delays in fractional T-1 or ISDN deployment? Around the block is too far to walk to a videoconference room?

Some of the past constraints on the growth of videoconferencing will soon be removed. First, today's corporate networks are digital, have T-1 internodal links, and use multiplexers that can deliver full or fractional T-1 rates to a videoconference room. Many of these networks can easily be upgraded to ISDN Primary Rate internodal links; replacement of line cards and addition of PC adapter cards (or other station equipment) will enable the provision of ISDN Basic Rate. As for codec standards, CCITT is expected to finalize the H.261 (informally called "px64") Recommendation. The H.261 standard will establish an encoding/decoding scheme and transmission rates at 64 Kbps and multiples thereof. Most major codec manufacturers have announced that they will conform to H.261. As for excessive codec costs, PC-based digital video coder-decoder (codec) cards now cost approximately US $10,000. Add a PC codec, headset, and a "chip" camera to a PC and the PC becomes a videoconference workstation.

Group 4 fax machines and PC codecs today have about the same price and minimum transmission speed requirement (56 or 64 Kbps). Will PC codecs have the same rate of adoption as Group 4 fax machines? Perhaps, but the early signs are not encouraging. PC-based codecs have been available for about two years, but market penetration is minimal. Videoconferencing may remain information technology's stepchild unless a new approach to marketing videoconferencing proves successful.

The adoption of videoconferencing, like the adoption of Group 4 fax, will probably have three stages: an early stage of one unit for the entire company, followed by one unit per floor or department, and ending with desktop units for high volume users. The first stage is the most critical. In the first stage, a company needs the hardware because its customers, suppliers, and competitors have the technology. Either the company buys the hardware or finds itself at a competitive disadvantage. Even with falling equipment and transmission prices, videoconferencing is not yet in the first stage. Something is still missing in the videoconference marketing equation.

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BUSINESS MEETINGS ARE FOR PROJECT MANAGEMENT

Why do businesspersons hold business meetings? For a number of reasons, but most of the reasons center on project management. Meetings are an interactive analysis and planning process. Even though business meetings are held to manage projects, one frequent and very serious defect in the meeting process is that assignments are misunderstood or overlooked. These misunderstandings and omissions may be detected and cured at the next meeting, but detection and cure may take several meetings (or, if uncured, could produce a breach of contract).

Videoconferenced meetings are not substantially different from face-to-face meetings. At both types of meetings, the attendees take notes, flag items that they are personally responsible for, and hope they weren't drifting or engaged in a side conversation during a key explanation or when something was expressly or impliedly assigned to them. The better produced meetings have agendas distributed beforehand and minutes of a meeting distributed soon afterwards. Most meetings, however, have sketchy or no agendas and if there are minutes, they may or may not be distributed before the next meeting on the subject. Is the former or latter project management? No.

Agendas and minutes, as essential as they are, are a small part of project management. Even with timely minutes, how long will the attendees wait before the PERT, Gantt, CPM, or other project management tool is prepared or revised to incorporate the reports, completed tasks, new tasks undertaken, and decisions made in the meeting? How long before the project schedules are distributed to the attendees? How easily can attendees revise or annotate the project schedules? The premise of this paper is that videoconferencing can best be marketed not by appealing to time and travel savings, but by emphasizing the contribution that videoconferencing-mediated project management services can make to the effectiveness of business meetings.

PROJECT MANAGEMENT SERVICES DELIVERED BY VIDEOCONFERENCE

Most managers readily admit that the classic project management techniques, such as Program Evaluation and Review Technique (PERT), Critical Path Method (CPM), resource histograms, and Gantt (milestone) charts, can be helpful or even essential to the competitive success of a company. These techniques have for several years been available as PC software. Yet, consistent use of project management tools is the exception rather than the rule in small workgroups and sometimes (often?) in projects like network construction, new product and software development, and other missions critical to company success. One reason for the lack of use of project management techniques is the amount of time, skill, and discipline required in the use of these techniques before the benefit obtained exceeds the "personal" resources expended in generating and distributing the project management reports. Many managers place a low priority on maintaining skills in project management software, ordering upgrades, and playing telephone tag with technical support personnel. Persons with the requisite time, skill, and discipline are a scarce resource and are often not co-located with the project members who need assistance in project management. This mismatch in location and skill presents a significant opportunity for videoconferencing.

The "unique selling proposition" of videoconferenced project management services is as follows:

1. Comprehensive and timely project management reports will greatly assist a technology company (Company A) in its management effectiveness and project completion. Such reports will include both minutes of meetings and graphics of task assignments, progress, difficulties encountered, and milestones. These minutes and graphics, including project schedules, could easily make the difference between Company A's new product being the first to market and capturing major market share, being the most responsive to customers, discovering snags in operations, or performing other important tasks well or poorly. Even more fundamentally, good project management will help to ensure that business the company would have obtained does not escape. It is not uncommon for many (sometimes most) of the responses to a Request for Proposal ("RFP") to be disqualified for being late or for a procedural technicality, such as omission of the certification that the person signing the proposal or the surety bond is authorized to do so. Good project management helps to ensure that responses to RFPs are timely and procedurally compliant.

2. Comprehensive and timely project management is presently nonexistent or rare within Company A, especially among geographically dispersed project members.

3. Company A has a digital network (either private, public, but probably hybrid), many PCs, and some employees who are touch typists, decent writers, and skilled in PCs and project management software (e.g., recent M.B.A. graduates). Alternatively, Company A can retain a consultant who has these skills and who will attend meetings on Company A's premises or has access to another "secure" videoconference facility. Both the internal staff and the consultant(s) that provide project management support services are hereafter collectively called the project management services staff.

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4. As a trial, Company A should install videoconference equipment in a conference room at the project management services staff site and at designated locations where project management support services are needed.

5. If the trial is successful, more videoconferencing units will be installed and videoconferenced project management support services will be mandatory for projects that match certain profiles. The project management services staff will expand and sites added as demand grows. Videoconferencing systems will populate individual departments, floors, and even desktops in the company.

Step 5 is, of course, the explosive growth in videoconferencing long sought by providers of telecommunications equipment and services. The success of such trials depends upon the quality of the project management support staff and the products they generate. What products should they generate and how should those products be distributed?

PROJECT MANAGEMENT SUPPORT SERVICES

Management training. The long term goal of "videoconferenced project management" is to make the use of information technology to gain competitive advantage an integral part of the corporate culture of the company. Corporate culture cannot be injected like a vaccine; it is absorbed osmotically by doing. The delivery of management training by videoconference is part of this osmosis. Management training should do more than explain the mission of the company, it should provide a means for trainees to match names of top management with their faces and nonverbalities, give remote middle managers access to peers and superiors, develop the leadership skills used in conducting face to face and videoconferenced meetings and personal communications, and generally be the loom on which the basic patterns of management socialization and strategic coherence are woven. Videoconferencing can, with its electronic threads, infiltrate a geographically dispersed company with management training (and the corporate management culture) far more pervasively than traditional meetings. The project management support staff would train managers via videoconference in, at a minimum, agenda preparation, meeting management, and the use of the hardware in the videoconference room and the software to be used during videoconferencing.

Business graphics, spreadsheet, database, and project management software training. The essence of meetings is the concise and easily understood presentation of information. This requires the extensive use of graphics, that is, business graphics PC programs (traditional artwork is too slow, inflexible, and expensive). Business graphics use as their source material the contents of spreadsheets and databases. This information is often classified as historic, present, and forecast, whether the subject is sales, parts, products, software modules developed, or other goods and services. Project management software is, of course, what most managers should be using but aren't.

Oversimplified, project management is the process of: identifying and describing major components required for delivery of a product or service; dissection of those major components into discrete tasks; describing the tasks; assigning personnel, equipment, services, and other resources to the accomplishment of the tasks; and the periodic review and revision of the performance of the tasks. Most PC-based project management tools produce graphics that depict the interrelationship of the tasks and highlight the series of tasks (critical path) in which any delay will delay the ultimate completion. Training in PC-based business graphics through videoconferenced instruction would acclimate videoconferees to inspecting and revising PC program displays generated remotely (by the instructor or other videoconferees) and displayed on the large screens (or on personal monitors) at each videoconference site.

The videoconference environment. The videoconference rooms used by videoconferees during a videoconference with project management support services could be little different from the better equipped of today's videoconference rooms. One wall of each videoconference room would be full of large monitors (rear projection systems could be used if the "trompe d'oeil" room design is used: in this design the local table abuts the screen displaying the remote site; the table extends from the screen into the room; the remote site has a similar table; the local table and the remote table appear to join, giving the videoconferees the feeling of being at the same table. This effect is often spoiled by the poor resolution of most videoprojectors.). The monitors (or videoprojection screens) should display each remote site, local preview signal, outgoing program feed, minutes, and software application in use. In addition to the wall monitors, each videoconferee might have a windowed CRT display, keyboard, and mouse. The windowed display could display any signal available to the wall monitors. Installing a workstation (either terminal or PC) at each videoconferee position would add cost, but may be necessary if large numbers of videoconference sites are involved. Multiple sites could be accommodated easily by windows on a display, but be impossible to accommodate on large monitors due to the limited area of the display wall in the videoconference room. Individual workstations would also permit e-mail or other groupware to be used by subgroups during the videoconference. A subgroup, for instance, might add detailed descriptions to line items in a budget or milestone chart.

Windowed videoconference workstation technology ("desktop videoconferencing) would be used by the project management support staff. The project management support staff do not need the illusion that their conference tables are "joined" with those of a remote site. It is more important for the support staff to be able to monitor the execution of software applications and the videoconferees on the same screen.

Desktop videoconferencing also holds great promise for videoconferees. Just as "plain" conference rooms are often booked weeks in advance, a full featured videoconference room would also be heavily booked. Multisite videoconferences populated by individuals using desktop, windowed, videoconference workstations and networked with the project management support staff are the third, or explosive, stage of growth of videoconferencing.

Videoconference meeting management and groupware. During a videoconference, the meeting chairperson would lead the videoconferees through a previously distrbuted (e-mailed) agenda. The chairperson and videoconferees would from time to time instruct the project management services staff to revise the various spreadsheet, database, and project management graphics that are displayed during the course of a videoconference. Videoconferencing is an ideal application for groupware, that is, software designed for either simultaneous (synchronous) or sequential (asynchronous) use by members of a group. At the present time, groupware is still asynchronous: even though the videoconference rooms in a multisite meeting can be interconnected by a wide area network that uses circuit- or packet-switched datapaths to all the videoconference rooms involved, if persons other than the project management support staff wish to make changes, the program must be saved and reopened by a person at a different site; only one person (keyboard) can work "in the program" at any one time.

Groupware of the future should permit synchronous use of a given datafile. Structured Query Language (SQL) distributed databases, which today permit such synchronous use, are the harbingers of this trend. Distributed SQL databases permit simultaneous access to different "fields" of a single database by different users. The phrase "single database" is slightly misleading; a single distributed SQL database may in fact be distributed (have its component parts resident) on several geographically distinct "server" computers, but appear to the users (called "clients" in the parlance of SQL) as a single database. Synchronous groupware will permit videoconferees competent in the software being used to simultaneously revise different parts of the data and have those changes reflected in real time to all videoconferees. Some groupware would work best in synchronous mode, such as CAD/CAM software. It would take engineers far longer to explain to non-engineers how to change an engineering drawing than it would the engineers to make the change themselves. Even when synchronous groupware is available, videoconference chairpersons may wish to run the groupware (e.g., word processing, project management software) in asynchronous mode and have the project management support staff input all revisions.

Videoconference Work Products. Two important work products produced during a videoconference by the use of the project management support staff are the minutes of the meeting and the project management schedules. Both would be developed interactively. The minutes would be displayed on a wall monitor (or in a window on a workstation) as they were being created and might be subject to frequent revisions by the videoconferees. The project management schedules would also be drafted by the project management support staff and refined by input from the videoconferees. If foreign language translation is required, the project management support staff could provide simultaneous translation during a videoconference; later review of the video and audio tracks might lead to improvements in the minutes and other work products. The audio, video, minutes, project management schedule, spreadsheets, engineering drawings, and other datafiles would be centrally stored (and, if necesary, downloaded to a videoconference site) and available thereafter as the "compound document" of that meeting.

COMPOUND DOCUMENTS

A compound document is a collection of related text, numberic, audio, video, and/or image files. Access to the compound document is through a graphics user interface (as opposed to character interface) so that the video and image files may be displayed (either as a direct pixel map, H.261, or uncompressed from Hoffman, Intel DVI, or other encoding). Digital audio signal processors (15 Khz or more analog output), are used to reproduce the audio files. Retrieval of a compound document might, for example, produce on a PC display windows containing images of faxes, photographs, a spreadsheet, a database, word processing documents, and full motion video. The soundtracks of the video, voice comments by colleagues reviewing the file, and other audio could be played back individually or as a mix. Compound document technology, including full motion video playback through windows on PCs, is commercially available today. Compound document technology was commercially pioneered by interactive videodisk products, but has spread to microcomputer platforms using hard and/or optical disk storage.

To reiterate, the compound document would contain character- and graphics-based datafiles, soundtrack, and videotrack of persons and software displays of a videoconference. To clarify an assignment, a person might wish to review the compound document to better determine the scope or direction of the work required. The audio and video components of the compound documents would take large amounts of storage. To conserve storage, as well as to prevent the audio, video, and other components from being subject to discovery during any subsequent legal proceedings, the company would probably institute a records management policy that required erasure of specified parts of the compound document after the expiration of specified amounts of time.

MULTIPROCESSOR MICROCOMPUTERS, COMPOUND DOCUMENTS, AND THE MARKETING OF VIDEOCONFERENCING

With the debut of Enhanced Industry Standard Architecture ("EISA") multiprocessor microcomputers in late 1989, microcomputers irrefutably entered the domain of minicomputers. A multiprocessor architecture is one in

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which either a master and several subordinate, or a bus arbiter and several peer, processors share access to the data bus in a computer. In EISA, the entire 32-bit data bus may be momentarily captured by a single processor, or several processors may be momentarily allocated 8-bit slices of the 32-bit data bus. Multiprocessor microcomputers have the processing throughput to simultaneously control high resolution (1024 x 768 pixels and greater) PC displays, multiple windows from Local Area Network/Wide Area Network applications, high fidelity audio (compact disk quality), multiple codecs, and multiple ISDN B or fractional T-1 channels. Multiprocessor microcomputers bring to the desktop the power to conduct multi-site videoconferences.

The advent of the multiprocessor videoconference workstation may skew the development scenario initially outlined above. Rather than build many videoconference rooms, companies may elect to jump directly to the videoconference workstation as the second stage of development. Smaller companies that provide goods or services to large automotive or aerospace manufacturers, for example, may never build a videoconference room. Instead, such smaller companies' first use of videoconferencing might be through videoconference workstations. Before multiprocessor microcomputers and PC-based codecs, there was no choice: the only access to videoconferencing was through the "wall full of electronics" approach and, if lesser picture, sound, and lighting quality could be tolerated, through the "some of the wall full of electronics cabinetized as a large cart" approach. A videoconference workstation could be used in an ordinary conference room with multiple displays slaved to the workstation display; input devices (keyboard, mouse, tablet, etc.) would be limited to the meeting chairperson.

Video coverage in the workstation approach could be one camera per workstation or the traditional wideshot of the room and closeup coverage of the person speaking used in today's videoconference rooms. One camera per workstation and a wideshot camera would be ideal. Normal coverage would be a tight shot of the person speaking and wideshots of all the remote sites. Even in videoconferences, a person normally is given the floor by raising a hand and being acknowledged by the chairperson. Thus, the need for the wideshots. Alternatively, videoconferees could electronically signal the chairperson that they wanted to speak; a means to electronically cancel the request to speak would be required.

CONCLUSION

Compound document software, multiprocessor microcomputer technology, and switched digital network availability now enable the provision of videoconferenced meetings that have a revolutionary level of project management support. The project management support staff would be remotely located (even distributed worldwide) and may be staff, consultants, or both. The project management services staff would monitor videoconferences in the way simultaneous interpreters monitor and translate during international conferences. The project management support staff would provide a range of work products, the two most important being minutes and project schedules. These documents, as well as budgets, databases, engineering drawings, and other application software outputs, would be developed interactively by videoconferees and the project management support staff and supplied in whatever languages were needed. Digital archives of the meetings and work products would be stored as compound documents at one or more sites and groomed according to the company's records management policy. The competitive advantage provided by the use of project management support services and compound documents would provide a very persuasive new selling proposition for the marketing of videoconference and telecommunications equipment and services.

1990-1994:
A Mobile Communications Revolution in the Making

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Abstract

In the early 1990's a confluence of technological advances in semiconductors, satellite design, and algorithm development will ignite a mobile and fixed-site telephony revolution which could have a profound impact on both the industrialized and developing regions of the world. However, regulatory issues and the need for improved international cooperation remain as impediments to universal, low-cost telephony.

Introduction

The human desire to communicate made major progress in the 1980's. The explosion in cellular telephony in industrial nations, the worldwide proliferation of high-capacity fiber and satellite links, and the advent of personal communications devices such as pagers, mobile data terminals -- even shirt-pocket cordless telephones -- are all parts of the global advance toward ubiquitous communications. New communications services, such as messaging and position location, are further evidence of the trend. But beyond even these startling advances, a true revolution is in the making. It is a revolution which not only will impact us and our constituents, but which will permit us to impact it: namely, the possibility of universal, low-cost telephony. This revolution will be made possible by advances in semiconductors, algorithms, and satellite design which are now in progress and which, over the next four years, will result in a plethora of new products and the network advances to support them. This paper will discuss the enabling technologies, review the projected products and services, and highlight some of the issues to be resolved before our collective goal of universal, affordable telecommunications can be achieved.

Technologies

Until the appearance of very small aperture terminals (VSAT's) in the early 1980's, the satellite infrastructure to support voice and data communications cost millions of dollars and earth stations cost hundreds of thousands of dollars. The size of the required investment effectively precluded quality satellite communications to rural and remote users. Around 1986, however, earth stations began to appear which could take advantage of newly-launched Ku-band (≈11-14 GHz) satellites and which could support high speed data and compressed digital voice for US$10,000 to $20,000 per terminal.

Unfortunately, Ku-band was ill-suited for large portions of the globe where low-cost communication is needed most -- the equatorial areas. Rainfall attenuates Ku-band signals more severely than lower-frequency C-band (≈4-6 GHz) or L-band (1.5-1.6 GHz) energy, and this attenuation results in either a poor quality of service, or a need for larger and more expensive earth stations and thus a more costly service when measured in dollars per call minute.

It should be noted, however, that the technological prime mover which led to VSAT's was television -- a desire to distribute television programming to the masses via high powered satellites and small (≈1 meter), low-cost receive-only terminals. Today, Ku-band technology makes possible two-way messaging to mobile and fixed terminals for a few thousand dollars per terminal and tens of dollars per month. Spot beam Ku-band satellites are planned for the 1990's which should further reduce terminal and service costs and increase capacity to support data and voice services. Still, Ku-band is not universal; nor does the prevailing regulatory structure allow its use as a primary resource for mobile communications.

The early and mid-80's also saw the introduction of small earth stations operating at C-band, the frequency of choice for domestic, regional, and international satellite communications. The Intelsat organization established a C-band satellite infrastructure which had global coverage. Improvements in satellite and earth station design eventually permitted novel small spread-spectrum terminals for data and information dissemination even in Equatorial areas, and terminals as small as 1.5 meters which could support high speed data or voice. C-band VSAT's using digital technologies adapted from the Ku-band experience are just now proliferating. Excellent quality voice is being implemented at 9.6 to 16 Kbps using powerful digital signal processors to compress voice and mitigate echoes. As with Ku-band VSAT's, C-band VSAT's sell in the range of US$10,000 and, through use of voice compression, these terminals can efficiently use expensive satellite capacity to reduce voice call charges. It is worth noting here that advances at Ku-band in industrial nations were required before low-cost C-band VSAT's became available for universal service. Nevertheless, the time lag between the two technologies was at least three years.

There is one other satellite infrastructure which has global coverage, albeit at L-band: the INMARSAT system. Originally chartered to provide global voice, data, telex, and distress messaging services to the maritime community, INMARSAT's network has also supported land-based voice and data services in emergencies and other special situations. L-band has the advantage of suffering minimal degradation in rain, making it ideally suited for a universal service. Currently there are about 7000 terminals worldwide which regularly access INMARSAT satellites. These so called "Standard A" terminals sell for US$25,000-$35,000 with voice calls costing approximately US$10 per minute. Because Standard A antennas are approximately one meter in diameter, they are less than ideal for small ships or vehicles. In response to demands for smaller and less costly terminals and services, INMARSAT has embarked on an aggressive development program which has already resulted in several new offerings:

Standard B -- A Standard A-like terminal which uses voice compression and other digital techniques to make more efficient use of satellite resources.

Standard C -- A two-way messaging terminal small enough for small vessels and even land vehicles and priced at less than US$10,000.

Standard M -- A two-way voice, facsimile, and data terminal small enough for small vessels and land vehicles and also priced at less than US$10,000.

The enabling technology for Standard B was again voice compression. The standard uses 16-kbps voice with an option for a lower rate. Very recently, INMARSAT approved an aeronautical service which will support telephony and data for use by both passengers and crew on international flights. This was made possible by the existence of 9.6-kbps voice compression yielding good voice quality, as well as by advances in flat and conformal tracking antennas. Widespread use of this service is expected to begin in the 1991-1992 time frame as more aircraft are equipped with the satellite terminals and more countries implement "hubbing" stations. Voice call costs will come down substantially in four to five years when INMARSAT launches its third generation satellites which are higher powered and support spot beams.

Low-cost L-band technology received a boost when Geostar proceeded with a novel position location and messaging service in the US in 1985. With the prospect of a marketplace for hundreds of thousands of small terminals unfolding, manufacturers such as Hughes, Kenwood, Sony, and Motorola have entered the L-band marketplace and have begun selling mobile messaging terminals for around US$4,000. Prototypes of a hand-held messaging satellite terminal exist today!

Concurrently, organizations in Australia, Japan, the US, Canada, and Europe, as well as INMARSAT, began to take a serious look at the feasibility of low-cost L-band telephony earth stations for mobile, rural, and remote applications. Several conclusions emerged from the numerous studies performed around the world:

1) Voice compression was the key to both lowering terminal cost and cost per call minute in the near term. Acceptable quality voice around 4.8 kbps (compressed some 13 times over 64 kbps PCM) was specified.

2) An additional longer-term key to reducing terminal costs and service charges was the launching of more powerful L-band satellites including the implementation of spot beams.

3) Digital modulation and coding techniques would be necessary which are processor intensive.

4) Advances in steerable antennas would be necessary until spot beam satellites allowed relaxation of the steering requirements, although steerable antennas would always yield lower service charges.

5) End-user prices for such terminals in the near term could not exceed US$4,000 for land mobile users, US$7,500 for maritime users.

In just this past year, much has happened to further the cause of low-cost, universal satellite telephony:

1. INMARSAT released a specification for its Standard M terminal and expects initial services to begin late in 1991 or early 1992.

2. AUSSAT released requests for proposals and tenders for its operational land mobile satellite system which awaits a launch late in 1991.

3. Geostar Messaging Corporation and the American Mobile Satellite Consortium (AMSC) filed for land mobile voice and data services in the US. The AMSC received approval for use of L-band resources for US land mobile and aeronautical services, and the consortium also issued RFP's for land mobile terminals and control facilities.

4. Telesat Mobile, Inc. of Canada awarded contracts for land mobile messaging terminals and central station equipment as well as issuing an RFP for an advanced satellite to support voice and data services later in the decade.

5. Land mobile voice tests were performed over Japan's ETS-V satellite in Australia and Japan. Tests were also performed with prototype terminals and subsystems developed by the Jet Propulsion Laboratory at Cal-Tech as part of the US MSAT program.

The stage was thus set, but how can companies such as our own possibly meet the technical specifications at the proposed cost targets? I assert here that cellular telephony will be to low-cost mobile satellite telephony what television DBS was to Ku-band VSAT's!

During the past five years, considerable work has been done to develop voice compression algorithms between 4.8 and 9.6 kbps which yield a subjective perceived voice quality difficult to distinguish from "toll quality." Some of this work has been funded by Government agencies interested in voice compression for secure telephones and radios. Some was in direct response to the explosive second generation cellular requirement.

The unprecedented growth in cellular telephone demand in Europe and the US created a need for a more efficient architecture which could support this projected demand. Digital techniques were assessed which could support many more users than the first generation analog approaches. Europe adopted the GSM standard which is currently being developed. It centers around voice which would be transmitted at 13 kbps with an option for even further compression. A US standard emerged during 1989 centered around an 8-kbps voice compression scheme introduced by Motorola. While this scheme is very processor intensive, it yields voice qualities difficult to distinguish from "toll quality." Furthermore, the digital modulation and coding techniques necessary to support the US standard require considerable processor power also. Hence, the challenge to the US and world semiconductor industry: Develop new generation digital signal processors which 1) can support the processor intensive voice compression and other digital schemes, 2) are low cost in cellular volumes, and 3) consume only small amounts of power so hand-held cellular phones are feasible under the new standard. Motorola, Texas Instruments, AT&T and others have already begun investing resources to meet this challenge and are developing the new processors needed to meet the initial digital cellular market demand in 1991. Fortuitously, these new processors which are capable of supporting the new voice compression schemes and digital techniques for cellular will be available for mobile satellite telephony later in 1990.

The same techniques used for digital cellular can be adapted for satellite communications, and can coincide with availability of second- and third-generation L-band satellites over the next four years. The results: Mobile telephony satellite terminals costing less than US$5,000 over the next two to three years; lower-cost terminals for fixed-site applications due to lower cost, fixed, higher gain L-band antennas; even lower cost terminals and services when third- generation L-band satellites go up in 1994 and 1995.

It is entirely reasonable to forecast that, over the next two years, we could see:

- Entire telephony earth stations in brief cases which can call from anywhere in the world via INMARSAT if permitted by regulation. Planar antennas will be built into the cover of the briefcase.
- Low cost, solar powered, emergency "call box" terminals that could operate domestically, where L-band resources were available and regulation permitted.
- Mobile terminals mounted on vehicles for business or emergency use supporting voice, data, or facsimile communications, where permitted.

The Issues

"Where permitted" is the key phrase. In the past decade, we have compressed voice some 13 times; we have lowered the price of earth stations by two orders of magnitude; we are on the threshold of a satellite technology which can be introduced to industrialized and developing countries simultaneously which will make universal telephony truly feasible; we can benefit from advances in semiconductors originally made for the cellular revolution to drive terminal costs to unprecedented low levels; and we can take advantage of new generation L-band systems being launched for domestic, regional, and international applications and services to lower terminal and service charges.

The keys today are not technology, not capital or recurring costs, but policy and regulations! Can INMARSAT's resources be used for operational land mobile systems world-wide? Can L-band assets launched by countries for internal domestic use be applied for regional services? Will more L-band bandwidth be made available for land mobile use? Will land mobile and fixed-site telephony be assigned primary status for additional L-band spectrum? These are the real issues today.

We, and the policy makers in our respective countries hold the future of this technology. The time is now to get involved in how L-band spectrum will be allocated; in what L-band resources can be used for what purposes.

Only five years ago, a friend of mine in Australia asked whether $3,000 earth stations were feasible which could support rural telephony, data and facsimile for educational purposes. The answer then was no; today it is yes! It will take some time to get satellites into space which can make "everyday" use affordable; it will take some time to ramp up production of these new terminals to drive the costs down to that $3,000 level; it will take some time to build the hubs that can support such services in each of our nations; it will take some time to sort through the policy and regulatory issues. All of this *can* happen in the next four years.

It is time to begin.

A SMART CARD PAYPHONE SYSTEM

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The Smart Card industry is alive and in good health and several important projects are on their way, among them the most important one is without question the association of the smart card with a public payphone.

1. HISTORY

The story begins in FRANCE in the early eighties when the rate of vandalism on the coin payphones operated by FRANCE TELECOM could not be tolerated any longer.
After an in-depth study of the existing card techniques, they decided to use the smart card as a substitute to the coins in a new generation of payphones.
In 1982, our company was selected by FRANCE TELECOM to participate in a field experiment. It included 200 payphones and ab[illegible]00 prepaid smart cards that SCHLUMBERGER also produced and delivered.
The results of the first pilot were very positive and demonstrated the real advantages of the smart card technology over the competitive card techniques.

- First of all, the system was widely accepted by the public.
- Then, the operator FRANCE TELECOM took the decision to proceed further and to install numbers of payphones, to provide large quantities of smart cards and to set up a nation wide distribution network capable to cover the whole country in order to ensure the success of their program.

This program is now 7 year old and 50.000 smart card payphones are installed and operate satisfactorily. About 4 million cards are delivered every month to meet the demand. Today in Europe, 5 countries besides FRANCE have already adopted the smart card for their public telephone system : WEST GERMANY, SPAIN, SWEDEN, LUXEMBOURG and NORWAY. Many other in Europe and outside Europe are seriously considering the smart card as the most appropriate solution for their public payphones.

2. THE MAIN BENEFITS OF A SMART CARD PAYPHONE SYSTEM

The main advantages of card payphone compared to a coin operated set are well known :

- No cash. Eliminates theft incentive, vandalism is nearly suppressed.
- No coin handling. Eliminates coin collection costs.
- Revenue per call increases because of the convenience of no coins.

On top of that, the most significant advantages of a smart card system are :

- Its reliability and simplicity - improved the availability of the payphones in the field.
- Its high level of security provided by the card itself - no fraud, no counterfeited cards.
- Its capacity to evoluate - upgradable to new cards and services.

3. THE PAYPHONE SMART CARD

First of all, I would like to recall the basic features of a smart card. A smart card sometimes referred as chip card or electronic card with the standard credit card dimensions. Instead of magnetic tracks, an integrated microchip is inserted in the card. The microchip enables decision and calcultations to be made in addition to storage of data.

3.1. THE PREPAID CARD

In a public payphone environment, there are basically 2 types of smart cards currently used :

- a prepaid card
- a TELECOM card

The prepaid card or debit card can be regarded as a purse containing tokens dedicated to pay for the phone calls. It has discrete bits of memory which are used to represent discrete telephone charge units. The chip essentially consists of a 256 bit memory divided in 2 zones.
Zone 1 (96 bits) contains information such as serial number, electrical parameters and prepaid value. This zone is locked by destruction of a fuse.
Zone 2 (160 bits) contains the payment units. The debiting of a unit is performed by writing of a bit to logic 1. Since the EPROM memory used is not erasable, alteration of the value units is impossible.

3.2. THE TELECOM CARD

The Telecom card or credit card was specially developed to be used by Telecom subscribers. Basically, this card is issued by the Telecom Administration with a view of providing

additional services to frequent callers.
It is used as a credit card which identifies the user through a PIN (Personal Identification Number) and can, as an option, record the data related to each call.
Compared with the prepaid card, the Telecom card has larger memory capacity and is divided in 7 zones.
In addition to the manufacturer zone, there are confidential areas like the application zone which can be accessed by use of the PIN, or the transaction zone where it is possible for the card holder to write into this area. For example, short code dialling is possible by inserting telephone numbers via the payphone keypad.
There are also secret areas which cannot be read from the card but are compared internally with data entered via the logic section. For example, the areas containing issuer code and user codes.
Calls made using a Telecom card are charged to the subscriber's telephone account. To provide blacklist information ... back up computers are required.

4. A NEW GENERATION OF CARD PAYPHONE

Based upon the experience acquired on the field with more than 25.000 smart card payphones in operation, SCHLUMBERGER has developed a new generation of payphone named the PF08 line.
The main objectives we had in mind when developing this line of products were :

- To offer a user friendly telephone set and above all to leave the user free to get hold of his card at any moment.

In this unit, the card is half way inserted and never disappears inside the machine as it usually does in standard magnetic card telephones where the user may be a little apprehensive that the machine never returns the card back.

- Another objective was also to provide an easy to install and maintain payphone.

For instance, the payphone is line-powered and does not require any additional power supply. The simplicity of the card reader also significantly reduces the cost of maintenance. You are certainly aware that, in a public payphone, the reader is a most delicate part, the more it is complicated, the more service it requires.

- A third objective was to provide the Telecom Administration with an open-ended system which gives them the possibility to upgrade it on site at their most convenient time and to offer additional services to their customers, like extension to new types of cards (credit telecom card, standard magnetic bank cards...).

- At last, one of our objectives was also to integrate the payphone inside a system.

A supervision center, based on a PC, installed anywhere in the network can monitor a batch of payphones and performs the following functions :

. Alarm management. The payphone can call the center as soon as its internal diagnosis system detects a failure.

. Reception and processing of data transmitted by the payphone (such as data related to phone calls made with credit cards, statistical data ...).

Wednesday, January 17

Morning Plenary

NOTES

Evolution of Pacific Network
Competitive Options for the User

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1. ABSTRACTS

The paper will outline deregulation in Japan and the birth of two new international carriers which, for the first time in the history of Japan, will provide competitive options for the user both in terms of services and availability of fiber-optic facilities from Japan.

2. INTRODUCTION

Ladies and gentlemen, I am very pleased to be given an opportunity to address you here today at PTC 90. I am very aware of the high regard that the PTC platform and forums are held in within our industry and I am naturally honored, as a relative newcomer to such events, to be able to speak to you today.

The title of my address to you is "Evolution of the Pacific Network and Competitive Options for the User". For those of us based in the Pacific region these two elements are, in my view, inextricably linked, affecting the supply side and demand side of our service industry. My own company, International Digital Communications or IDC has been formed to serve these elements as basic objectives. Later in my talk I would like to give you more details about IDC and our progress to date, and in particular to update you on our North Pacific Cable project.

The twin themes of my talk, network evolution and competitive user options, have of course been given considerable impetus by the political process of deregulation or liberalization. I would like to briefly touch upon this important political 'motor for change'.

3. LIBERALIZATION OF TELECOMMUNICATION BUSINESS

The telecommunication business had been, in principle, monopolized for many years in every country in the world. This can be easily understood when we think of the importance of telecommunications and its enormous cost. Therefore in most countries the monopoly carriers were, and still are, government departments or at least government corporations.

Deregulation as a process has its roots in the United States, the largest and most influential market for telecoms services. However, telecom companies in the U.S. have long been private enterprises, and the deregulation model effected there, with the break up of AT&T, founded other variations in the U.K. and Japan where a process of privatization and liberalization has been introduced.

In Japan the enactment of the new Telecommunications Business Law and NTT Law in 1985 resulted in the part privatization of NTT and the removal of NTT's monopoly on domestic services in Japan. A significant number of new common carriers now offer public telecom services in Japan in competition to NTT. International services from Japan were also opened to competition with the licensing of two new international carriers in 1987, one of which is IDC. In addition to such facility based competition, Japan has witnessed a prolific expansion in the area of value added services.

Our experience to date in Japan is that the liberalization process has successfully spawned competition, giving greater customer choice at lower rates. Out of this mixture I believe we will in future witness a growing number of new services brought about by private sector innovation.

Deregulation, while essentially a political process, has been largely caused and driven by customer demand for choice in the provision of services and facilities and for lower prices.

4. REMARKABLE GROWTH OF DEMAND IN JAPAN

I would like to call the 19th and 20th centuries "an era of goods", and we are now getting close to the 21st century which I deem "an era of information".

Until 120 years ago, communication in Japan was not an easy thing and it was extremely expensive. In those days, if a person in Yedo, Tokyo's old name, wanted to send a message to Osaka, he had to ask a hikyaku, courier on foot, to carry it. It took 6 days to get to Osaka with a very expensive charge. Then telegraph was brought to Japan, the modern mail system was introduced, and later came the telephone. And now, within only 100 years or so, there is a flood of information in circulation. Japan is becoming one of the world's hubs in business, finance and other areas. Tokyo is linked with other cities of the world and keeps working around the clock. Recently, the growth of telecommunications traffic is over 30% per annum.

Other factors such as growing customer requirements for more sophisticated services and the movement to digital technology have combined to increase marketplace demands for choice in the provision of services.

Under these circumstances it was very natural that a strong requirement for a competitive environment arose.
Both NTT and KDD had been for many years monopoly carriers in Japan. While there had been no criticism of the quality of service provided by either NTT or KDD, it was nevertheless true that users had complained for a long time that prices from Japan were very high and that there was a lack of flexibility in meeting customer service requirements.

5. HOW WAS IDC BORN AND WHAT CAN IDC CONTRIBUTE?

IDC was born not to share an existing pie with other competing carriers in Japan, but to benefit the users by introduction of competitive options. The benefits are, in a word, substantial tariff reduction, flexibility in dealing with customers' requirements, and introduction of a variety of new services. One thing very clear is that the first one has already been realized to a great extent. The tariff for international calls from Japan has been reduced remarkably in the past two years. In fact it is now cheaper to telephone from Japan to the USA than from the USA to Japan.

In order to achieve these future objectives of IDC, I would like to explain what IDC has been intending.

(1) In order to be a successful international carrier in a short time-frame, we have tried to combine Japanese management with foreign expertise. The management know-how from such core shareholders as C. Itoh and Toyota and the technical support from NTTI are augmented by the expertise provided by Cable and Wireless and Pacific Telesis, our other core shareholders. I hope that one plus one here produces three or even four.

(2) IDC realizes the importance of having basic facilities of its own. The best example is North Pacific Cable (NPC). From the very beginning of its planning stage, IDC realized the importance of a high capacity digital link with the U.S. which is Japan's most important partner in every aspect; economical, political, cultural, etc. And IDC decided to construct NPC with its partners, Pacific Telecom Cable of the U.S. and Cable and Wireless of the U.K.

(3) In November '89 we signed a Memorandum of Understanding with Telecom Singapore and Cable and Wireless, Hong Kong, Limited to construct another major cable system providing large capacity fibers between Tokyo, Singapore and Hong Kong. Provision has also been made for a fiber link to Shanghai which is currently under consideration by the Chinese Ministry of Communications.

(4) IDC is trying to make its management and organization as slim as possible so that costs can be contained to a minimum.

(5) One more factor is IDC's international switch, a DMS300 manufactured by Northern Telecom; this switch was chosen by IDC because of its popularity with other international carriers and its corresponding compatibility with regard to service enhancements or new services.

Now what kind of developments has IDC made so far?

(1) In November 1987 IDC was granted a Type One Carrier license, or an international carrier license, by the Japanese government.

(2) In 1989 two earth stations for INTELSAT satellites were constructed, and an international gateway center in Yokohama which houses our switching and transmission facilities was inaugurated.

(3) In May 1989 we commenced leased circuit services.

(4) In October 1989 we started switched telephone service.

There are more developments to follow:

(1) We are working aggressively to increase the number of countries which we serve.

(2) Another international gateway center will be constructed in Osaka this year.

(3) At the end of this year NPC will be completed and put in service. At the same time we will complete construction of the Miura-Chikura Cable, which is an important connecting cable between NPC's landing station and KDD's landing station of such cables as TPC-3/HAW-4 and HJK.

(4) We will develop a variety of new services to cope with customers' ever changing requirements.

6. WHAT CAN NPC CONTRIBUTE?

The telecommunications demand in the Pacific region is exploding. As you are well aware, the first transpacific optical fiber cable, TPC-3/HAW-4, was put into service last year, and all of its capacity is now allocated. The demand for cable transmission has been growing more rapidly than everybody expected.
When completed, NPC's capacity, which is 1260 Mb/s, will be along with PTAT-1 the world's largest. This dramatic increase in capacity by means of new technology results in a considerable cost reduction per circuit.

You will be interested to know that the first data gathering meeting, held in Tokyo in September last year, was a large success; over a dozen carriers have committed to take capacity and the cable is already over 45% subscribed. The importance of telecommunications is paramount, and it is extremely important for every carrier to have route diversification. In this respect NPC will play a very important role in the Pacific together with other cable systems.

IDC as the original owner at the Japan end has unlimited potential to fully utilize this huge capacity and to meet the growing demand and to develop various new services which have previously been restricted because of the cost of bandwidth.

7. CONCLUSION

IDC is only a newly born carrier. However, I can say that IDC is steadily growing through cooperation and support of the telecommunications industry. IDC will be a high capacity facility-based carrier with an emphasis on fiber optic cables and wide range of dynamic services.

I firmly believe that every IDC man is full of energy and a spirit of challenge. I sometimes tell people that the letters IDC can also be read as Intelligence, Dedication and Challenging spirit.
It is our challenge, as the management of IDC, to capitalize on these characteristics in order to provide a truly superior international telecommunication service.

I sincerely wish that all of you present here will give a continued support to IDC so that we can achieve our objective to contribute to the society and businesses in the Pacific Region and also the world.

International Satellite Communications In The Pacific: Development and Future Prospects

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1. ABSTRACT

The development of international satellite communications over the past quarter of a century has made a substantial contribution to availability of high quality communications in the Pacific and the rest of the world. INTELSAT and its 118 members have played a pivotal role in this development and believe that INTELSAT continues to have an important role to play in a more competitive telecommunications environment. INTELSAT is pursuing a number of initiatives to accomplish this objective and to extend and maintain services in the Pacific basin.

2.INTRODUCTION

1989 was a memorable year in the development of international satellite communications. It was the year that INTELSAT observed the 25th anniversary of its formation and its achievements in expanding global telecommunications services. It was the year that the world was witness, live via the INTELSAT system, to pictures of history-making, mind-reeling political events in China, Eastern Europe, and just recently, Malta. It was the year that the world's most complex commercial communications satellite, INTELSAT VI, was successfully launched and deployed. It was the last year of a decade of change in the international telecommunications environment.

1990 will be no less memorable. It is the year that will see the largest ever broadcast of World Cup Football and the 11th Asian Games. It is the year that marks the beginning of a decade that will see at least ten new INTELSAT satellites enter service. It is the year that heralds a new decade of accomplishment in the provision of high quality, reliable, and economic global communications services. The past is indeed prologue for developments in international satellite communications.

3. CREATING THE GLOBAL VILLAGE

INTELSAT and its members have played a pivotal role in transforming a disparate communications world into a ubiquitously linked global network. The often touted global village is here: it is just as easy to communicate between Singapore, Sydney, and San Francisco as it is to phone your neighbor; it is just as easy to know what's happening in Europe and Asia as it is to find out about what's happening in local politics.

Whether the mechanism is a telephone, a radio, a television, or a computer terminal, the world today is inextricably linked through the invisible electronic pathways of the INTELSAT global system. We've achieved this degree of connectivity in a scant 25 years through the application of satellite technology and through the implementation of a unique organizational scheme for managing its development. In all of its efforts, INTELSAT has been spurred onward by a mission: the provision of expanded telecommunications services to all areas of the world with its concomitant contribution to world peace and understanding.

How well this mission has been achieved is reflected in the type and extent of traffic carried through the INTELSAT system. Since INTELSAT launched its first satellite, Early Bird in 1965, full-time traffic carried on the INTELSAT system has increased almost 800 fold, from 150 full-time channels in service at year-end 1965 to almost 120,000 full-time channels as of year-end 1989. About 20% of these full-time channels are digital. The INTELSAT system also carries nearly 100 full-time leases of which more than a third are for domestic services, a third for video services, and the remainder for a combination of specialized business applications, cable restoration, and maritime services.

What does all of this mean for the nations of the Pacific basin? Communications satellites are uniquely capable of responding to the diverse communications needs of the Pacific, where requirements range from sophisticated business network applications to remote inter-island links. This is attested to by the fact that all of the Pacific basin nations use the INTELSAT system; five Pacific Rim nations are among INTELSAT's top ten users, the United States, Japan, Australia, Canada, and the Republic of Korea. The Pacific has been INTELSAT's fastest growing service area in recent years. For the past ten years, the average rate of growth in full-time service in the Pacific has exceeded 20 percent per annum. At year-end 1989, INTELSAT provided almost 23,000 full-time channels in the Pacific Ocean Region for voice, telex, facsimile, and data transmission. In addition, INTELSAT's Pacific satellites carried more than a dozen long-term leases for video, domestic, and business applications.

Currently, the majority of full-time service in the Pacific is analog public switched telephony. However, more than 20 percent of full-time Pacific service has been converted to digital in the past year or two, reflecting a trend in INTELSAT operations worldwide.

This trend to digital is rapidly gaining momentum and is one which INTELSAT is actively encouraging to achieve greater operational efficiency in the use of the orbital spectrum resource available to the fixed satellite services. The INTELSAT system is anticipated to be predominantly digital by the early 1990s.

INTELSAT is also seeking adoption of standards for an integrated services digital network (ISDN) that recognize the role that communications satellites play in global communications. This goal is important to INTELSAT's members because many of them are charged with overall responsibility for international telecommunications whether via satellite or submarine cable. Path diversity and the ability to rapidly switch traffic between cables and satellites is necessary to ensure that international communications services remain reliable and secure. Satellite compatible ISDN standards are also necessary if global communications connectivity is to be maintained and flourish.

Several key principles upon which INTELSAT is founded have contributed greatly to the high degree of connectivity which the INTELSAT system is able to provide in the Pacific and elsewhere. Any nation, whether or not a member, may use the INTELSAT network. All nations, whether or not members, pay the same rates of charge for the same services. INTELSAT is obligated to serve countries with large traffic requirements as well as those areas whose communications needs are for as few as a half dozen international telephone calls per week. Thus, over the past 25 years the INTELSAT network has evolved to include virtually every country and territory in the world; 118 nations are members and almost 180 countries, territories, and dependencies use INTELSAT satellites.

Another key factor contributing to the connectivity of the INTELSAT system is its reliability. Since INTELSAT's reliability consistently exceeds 99.99%, the system is routinely used to restore service carried by undersea cable systems, including those utilizing fiber optic technology. In the last four years alone, INTELSAT has restored almost one and one half million channel days of cable service. As the capacity of cable systems increases, INTELSAT's importance to its members in the Pacific Ocean Region and elsewhere for media diversity and for restoring failed cables increases.

Dramatically decreasing costs have also helped to expand the scope of the INTELSAT network. In 1965 the monthly cost of an INTELSAT voice channel was more than U.S. $2,500. In 1989, by taking advantage of all the service and tariff initiatives available, INTELSAT members can obtain a voice channel for about one U.S. dollar per day.

With these initiatives, INTELSAT and its members have made a vital contribution to the creation of the communications infrastructure for the global village.

4. EXTENDING THE GLOBAL VILLAGE

This global communications village is self-perpetuating. The more service is available, the more the world demands. We have seen this chain of events quite dramatically in the Pacific Ocean Region. In response to this development and to the initiatives of our Pacific users, INTELSAT has designed and procured a new generation of spacecraft for Pacific requirements in the 1990s, INTELSAT VII.

The first INTELSAT VII satellite is scheduled for launch in the Pacific in mid-1992. It is currently anticipated that two INTELSAT VII spacecraft from the initial INTELSAT VII procurement will be deployed in the Pacific Ocean Region at the 174°E and 177°E locations. Each INTELSAT VII will have the potential for up to 90,000 simultaneous two-way telephone circuits using digital circuit multiplication techniques, plus three TV channels.

Like the current INTELSAT V series deployed in the Pacific, INTELSAT VII will operate in both C-and Ku-bands. Compared with the INTELSAT V series, however, INTELSAT VII spacecraft will have much higher power and improved beam coverages, particularly at Ku-band, and will thus yield significantly higher usable capacity in orbit. These design features have a number of beneficial implications for INTELSAT services in the Pacific.

The e.i.r.p. capabilities of INTELSAT VII have been chosen to suit Pacific requirements for smaller earth stations (8 to 10 meters). These high e.i.r.p. levels will permit optimum utilization of INTELSAT VII spacecraft with smaller earth stations and more efficient operation with smaller earth stations than is possible with prior generations of INTELSAT satellites.

New design concepts that have been incorporated in the INTELSAT VII satellites will enhance INTELSAT's service offerings in the Pacific. INTELSAT VII will provide C-band spot coverage that is independently and fully steerable over the earth's disk. This feature will permit flexible C-band coverages to serve the international and domestic requirements for many countries from different orbital locations.

For example, this new design feature can be used to enhance the provision of INTELSAT's Vista service. The unique configurability of INTELSAT VII coverage makes it possible to construct a Vista network using global coverage to serve rim countries with larger antennas and C-band spot beam coverage for island nations using smaller earth stations. The higher power C-band spot beam can also be utilized to provide improved television services in the Pacific.

INTELSAT VII C-band zone beams will be able to operate in an enhanced zone mode. In this mode of operation, the number of transponders within these zones can be selectively increased and decreased by ground command. This mode of operation permits the C-band satellite zone transponders to be used optimally over different coverage areas according to the traffic demand in each deployment location.

INTELSAT VII will have three K-band spot beam coverages. Each beam is fully and independently steerable over the earth's disk. A total of ten transponders are selectively assignable between the three K-band spot beams to provide a flexibility heretofore not achievable on INTELSAT satellites. The East and West spot beams are individually switchable by ground command to the third spot beam to enable full utilization of the Ku-band transponders for international and domestic services and INTELSAT Business Service (IBS). The third spot beam provides additional flexibility for provision of IBS service in the Pacific. Since the third spot beam can operate on a transponder by transponder basis in different frequency bands by ground command, the same IBS frequency band can be used in two different coverages simultaneously.

Requirements for capacity in all ocean regions are expanding so rapidly, however, especially for television and business network applications, that even the additional resources that will be provided by deployment of INTELSAT VI and VII spacecraft will not be sufficient to meet future needs. In recognition of this fact, INTELSAT made arrangements to purchase and launch an all Ku-band spacecraft in the Atlantic Ocean Region in 1991. Known as INTELSAT-K, this satellite will greatly enhance INTELSAT's ability to provide high power Ku-band service to the broadcasting industry, as well as other market sectors.

INTELSAT also pursued and won the contract for C-band capacity on the U.S. National Aeronautics and Space Administration's tracking data and relay satellites in the Atlantic and Pacific Ocean Regions. Since these two satellites are already in orbit, the contract will result in the immediate availability of 12 additional C-band transponders in both ocean regions. While the award of this contract to INTELSAT is in litigation, we are confident that NASA's decision to award this capacity to INTELSAT will be upheld.

5. MAINTAINING THE GLOBAL VILLAGE

INTELSAT's success in fulfilling its global mission has helped spawn our own competition. The challenge of competition is one which INTELSAT faces not just in the Pacific, but in the Atlantic and Indian Ocean Regions as well. Thus, questions have been raised regarding INTELSAT's ability to maintain the network and services it has developed in the face of increasing competition from providers of both cable and satellite services.

INTELSAT and its 118 members are firm in their belief that the INTELSAT system should and will be maintained in a telecommunications environment characterized by change. INTELSAT and its members believe that INTELSAT has been a tremendous success, that a single global satellite system remains a valid concept, that INTELSAT is a strong and flexible organization, and that INTELSAT should continue to provide an efficient, reliable and growing communications satellite system available to all users on a global basis.

This does not mean that we are ready to dismiss the impact of these other service providers on the provision of global telecommunications and on INTELSAT's role in this environment. INTELSAT's response is positive, and our support from our member nations remains strong and vigorous. Our response is to be competitive and to win on market principles. We hope to do this by providing a system that meets members/users wants and needs and by maintaining and developing a system that makes members and users want and need the system.

Over the past year and a half, INTELSAT and its members have been taking an intensive look at the global telecommunications environment of today and tomorrow to determine INTELSAT's role in this environment. We've analyzed the needs of our members and users and evaluated the strengths and weaknesses of ourselves and our competition. We have used the results of this analysis and evaluation to develop a program for action that will enable us to survive and prosper.

Several conclusions have emerged as a result of this effort and have become the focus for our strategic initiatives. These include: pricing initiatives to retain traffic and secure long term service commitments; service development to respond to changing demand and market requirements; technical and operational initiatives to ensure the continued availability of high quality, reliable, and sufficient space segment capacity.

The objective of INTELSAT's pricing initiatives is to give members maximum flexibility to acquire and configure space segment capacity to suit their needs at minimum cost. INTELSAT's tariff policies have been designed to encourage members to commit to long term use of the system for large amounts of traffic. This approach gives INTELSAT a core base of traffic and enhances its ability to retain traffic. Members have the benefit of significantly lower charges by making long-term commitments for use of capacity, larger blocks of capacity, and conversion to digital services. So far, our strategy appears to be paying off. Almost two-thirds of INTELSAT's full-time traffic has been converted to fixed and long-term commitments.

The goal of INTELSAT's service initiatives is to provide and configure capacity in ways that are responsive to changing patterns of user demand. Both the amount of traffic and the range of services which INTELSAT is called upon by its members to provide is expanding. In particular, requirements for domestic and regional, business, and broadcasting applications are growing.

To enhance members' ability to utilize the INTELSAT system for domestic and regional services, INTELSAT has introduced a new service allowing for flexible accommodation of both domestic and international traffic on INTELSAT satellites through unrestricted use of bulk INTELSAT capacity. This new offering is consistent with INTELSAT's move toward resource based charging and the goal to give members maximum flexibility to use capacity in accordance with their traffic requirements.

INTELSAT's business and broadcast services have soared in recent years in response to growing worldwide requirements for private network voice, data, and videoconferencing and global transmission of news, sports, and entertainment programming. INTELSAT Business Service (IBS) has increased more than six times since 1986 and is estimated to increase by one-third in 1989 alone.

All categories of video services have experienced very healthy growth. Since 1982, revenues have more than tripled. As the broadcasting industry becomes more global, video demand is expected to double again in five years. Provision by INTELSAT members of occasional use video services has also increased dramatically, driven by the peaks of the quadrennial global sporting events, the World Cup and the Olympics, and bolstered by the continuing demand for worldwide news, sports, and entertainment coverage.

Technical and operational initiatives reflect INTELSAT's unique requirements in terms of the system's global connectivity, multiple access, and service menu. It is therefore important that INTELSAT take a lead in developing technology to enhance services in these areas. INTELSAT intends to do this by pursuing a highly focused research and development program designed to keep INTELSAT on the cutting edge of relevant technology to maximize our competitive advantage.

Given the rapid growth in demand and the delayed schedule of launches, INTELSAT is utilizing techniques to extend the useful life of existing INTELSAT V and V-A spacecraft through the use of inclined orbit operation. Extending the usable life of existing spacecraft increases the value of system assets to INTELSAT members. These extended life satellites are useful for contingency service and cost effective cable restoration.

In addition to our major spacecraft programs, a number of other initiatives are underway to enhance the quality, security, and reliability of the INTELSAT system. One major factor in this process is the evolution toward digital operation which is a major part of INTELSAT's strategy to ensure system quality remains at a very high level.

In addition, INTELSAT is increasing its efforts to assist members in their digital conversion so that the INTELSAT system will be more than 50% digital by the early 1990s. Thus, the majority of communications links provided by INTELSAT for the global village will be digital and ISDN compatible.

6. CONCLUSIONS

The communications infrastructure for the global village is in place and functioning well. Transmissions of all types flow between the nations of the world, across thousands of miles, as easily as they do if carried on the local exchange. These developments have been of substantial benefit to the geographically disperse nations of the Pacific basin.

INTELSAT and its members have made a vital contribution to the creation of this communications infrastructure for the global village. INTELSAT plans to continue to play a major role in the provision of international satellite communications to users in the Pacific and the rest of the world. We are focusing our energies to sustain and enhance the momentum of the past 25 years. We have the flexibility and the willingness to respond to change. We are taking the initiative to forge our own destiny. We are a dynamic organization committed to serving our members and working with them to provide a global communications network responsive to their requirements.

Session 5.1

Distance Learning - Technology and Techniques I

NOTES

NESPAC: A TWO-WAY SATELLITE EDUCATION NETWORK

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1. ABSTRACT

NESPAC is a intra-corporation distance education system using satellite communications which is developed by NEC and is operational since 1987. The system realized full educational communications between the instructor and the students with realtime two-way video and two-way audio on the point-to-multipoint basis. This paper describes the system overview and its usages.

2. INTRODUCTION

2.1 BACKGROUND

In accordance with our business expansion ever since 1960's, we have many branches and subsidiaries across the country for our sales and productions activities. Among these subsidiaries, 27 companies are specializing in production and 32 are in software. Then approximately sixty percents of the NEC Groups' 134,000 domestic employees are now working outside the Tokyo Metropolitan area.

A wide spectrum of education programs including management, technology, sales, software, internationalization, etc. have been provided for the Group's employees. Many of these courses have been held in education centers in Tokyo area by gathering together students from various parts of the country, while some courses held in outside Tokyo area by sending instructors to provincial education facilities.

Therefore, it has become very important that we should eliminate the difference in educational opportunities between Tokyo-based employees and others. In addition to this problem, we should satisfy increasing educational demand with advances in technology and expansion of our business activities. But it has become difficult to meet all these requirements only by traditional collective and direct education.

In order to realize these problems a solution has been given by applying satellite communications that has many advantages, such as wide coverage, broadcasting capability, broadband transmission, multiple accessibility, etc.

2.2 THE NESPAC NETWORK

NEC has leased for the NESPAC one transponder of the JC-SAT1 domestic communications satellite. The NESPAC utilizes two 1.544Mbps satellite digital lines for one NESPAC course at a time. One satellite digital line is used for broadcasting the lecture from an instructor who is in a Studio or Center Classroom in the Satellite Education Centers (SEC's) and the other for broadcasting the return video and audio from one of the distant Satellite Classrooms (SC's). The SEC has the right to configure the network for a NESPAC class. Currently, the NESPAC has two SEC's in Tokyo and Kawasaki and 14 SC's in 10 cities in Japan as shown in Figure 1.

3. EDUCATIONAL COMMUNICATIONS IN THE NESPAC

3.1 SIMULTANEOUS TWO-WAY AUDIO-VISUAL COMMUNICATIONS

(1) Requirements

It is believed that educational communications between instructors and students should be

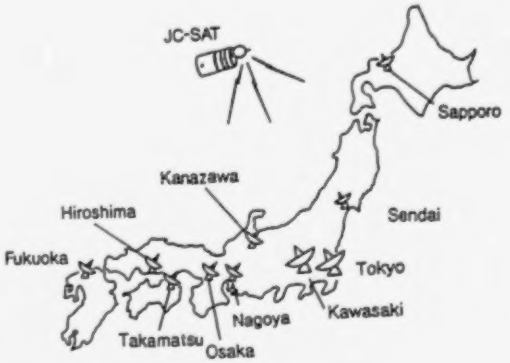

FIGURE 1. THE CURRENT NETWORK OF NESPAC

face-to-face. Because the more interactive the communictions are, the more effective the education will become. This type of educational communications with strong interactiveness that is usally realized in traditional classrooms is most important for the case of distance education also.

Therefore, the NESPAC system should enable to expand a traditional classroom to the spatially distributed classrooms without sacrificing the quality of education. In other words, the NESPAC system should realize media transparency to the students, or should realize equal environment for the educataional communications to all partipating students wherever they are attending classes with or without the instructor.

Hence the following requirements have been formulated for the system design concept:

- Realtime two-way video and two-way audio communications like face-to-face communications are necessary.
- Simultaneous transmission of two channels of motion pictures is needed. Because instructor and course materials are the essential educational information to be presented to the students in the classes.

Figure 2 illustrates the manner of the NESPAC's educational communications.

(2) The Key Technologies

The key technologies to realize the simultaneous two-way communications with video and audio include those for a video CODEC, an acoustic echo canceller. Figure 3 shows the concept of the system configuration.

Video CODEC Technology

In order to transmit pictures of both instructor and course materials via satellite more cost-effectively, NEC's television encoding and bandwidth compression technology (NETEC-XV) is applied. The NETEC-XV TV CODEC enables to send and to receive two channels of motion video and one channel of audio simultaneously in a 1.544Mbps digital line.

Acoustic Echo Canceller

In addition to the above features, the NESPAC utilizes wide band acoustic echo canceller (AEC) which eliminates howling and echoes caused by acoustic couplings between microphones and loudspeakers under a long satellite transmission delay of about 0.5 - 0.6 milliseconds. By this technology the instructor and far-away students can enjoy more natural conversations with "in person" quality.

3.2 POINT-TO-MULTIPOINT TWO-WAY COMMUNICATIONS

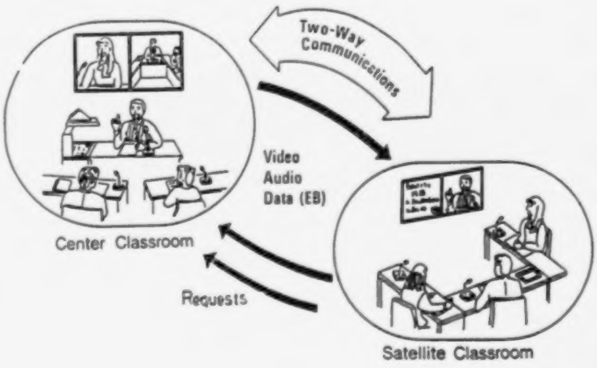

FIGURE 2. EDUCATIONAL COMMUNICATIONS IN NESPAC

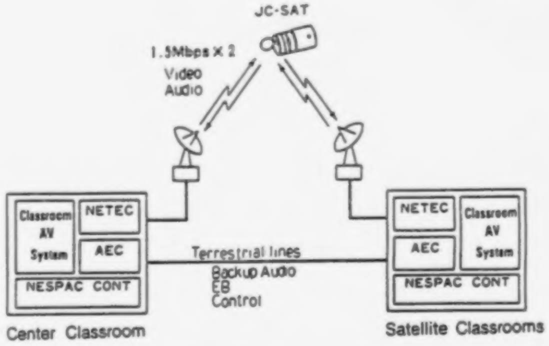

FIGURE 3. THE SYSTEM CONFIGURATION OF NESPAC

(1) Requirements

In order to realize efficiently the two-way communications between the instructor and the students using two satellite digital lines on a realtime point-to-multipoint basis during the class, the following requirements have been formulated:

- Students at any distant Satellite Classroom participating in a class can ask questions at any time in the course of the class.
- Instructor at a Studio or at a Center Classroom can receive requests from far-away students and accept one among the requests.
- The instructor and the student at a Satellite Classroom can talk simultaneously each other like face-to-face location by means of video and audio.
- Students at any other participating Satellite Classrooms can also receive and share simultaneously the discussion between the instructor and the student by video and audio.

(2) Educational Communications Control in the NESPAC

The NESPAC network configuration for a class is assigned before the class starts. The Studio or Center Classroom from where the instructor sends the lecture and the Satellite Classrooms to participate the class are selected on the Master Control Panel in the Satellite Education Center.

One of the two satellite digital lines is used for broadcasting the lecture from the instructor. The other is for broadcasting the return video and audio from the distant classroom which is assigned the right of discussion by the instructor among participating Satellite Classrooms during the class. We call this type of broadcasting control as 1:N Multipoint Control which is illustrated in Figure 4.

The communications between the instructor and the distant students are controlled by both instructor and students. For this purpose, the NESPAC has two special devices for the instructor and the students. They are the Studio Pad (SP) for the instructor and the Student Request Pad (SRP) for the students. The SP is located on the console in the Studio or the Center Classroom. The SRP's are on every student's desk in the Satellite Classrooms as well as in the Center Classrooms. These pads are shown in Photographs 1 and 2.

The NESPAC has two modes of the communications control, the monitor mode and the discussion mode. In the monitor mode, the instructor can monitor students in remote classrooms by just pressing the button on the SP corresponding to the Satellite Classroom which the instructor wants to monitor. In this mode, the pictures from the distant Satellite Classroom are not broadcasted and can be watched only by the instructor. In the discussion mode, the instructor can permit a Satellite Classroom to transmit conversations with the students in the classroom by just pressing the appropriate button on the SP. In this mode, the pictures and voices from the Satellite Classroom can be watched and shared by all the participating students.

When the students in the Satellite Classrooms use SRP to request discussion with the instructor or with students in the other Satellite Classrooms at any time in the class, the request indicators of the SP corresponding to the requesting Satellite Classrooms flush and the buzzer sounds for the instructor to be aware the request. The instructor selects one Satellite Classroom among the flushing Satellite Classrooms, then the second satellite digital line is assigned to the Classroom and the two channels of video and one channel of audio are uplinked from the Classroom.

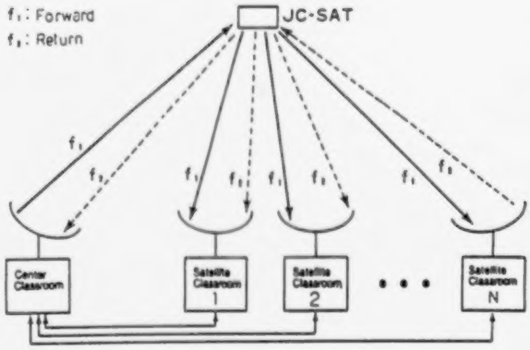

FIGURE 4. POINT-TO-MULTIPOINT COMMUNICATIONS CONTROL IN NESPAC

4. AUDIO-VISUAL SYSTEMS FOR STUDIOS AND CLASSROOMS

4.1 TYPES OF STUDIOS AND CLASSROOMS

The NESPAC has two types of studio from where the instructor broadcasts the lecture. These types include the Studio without students and the Center Classroom which is a studio with students. Classrooms without instructor are called the Satellite Classrooms. Photographs 3 and 4 show a typical Center Classroom and a Satellite Classroom respectively.

The classroom types in capacity are 12-student type, 30-student type, and 300-student type. These classrooms are selected and networked for a NESPAC class according to the number of participating students and/or teaching style.

4.2 THE MEDIA

In the NESPAC the audio-visual media are unified among all Studios(or Center Classrooms) and Satellite Classrooms to use two channels of full motion pictures, voice, and electronic blackboard (EB).

Studios

The instructor in a Studio or Center Classroom can present course materials by using overhead document cameras, videotapes, PC graphics, etc. All these video and audio outputs from the Studio/Center Classroom are easily operated by using equipments on the console including the Studio Pad. For a visiting instructor or an instructor who is just the beginner to instruct a NESPAC class, an operator can support the instructor from the adjacent operation room which contains the same equipments as the control equipments on the instructor's console.

Classrooms

In the front of the Satellite Classroom is a set of video-monitor package (which we call the Package System) that contains two sets of a large screen multi-sync video projectors and a small sized monitors. The large screen video projectors are for displaying the two channels of video from the Studio(or Center Classroom) or from other remote Satellite Classroom. Small monitors are for displaying the picture of the student who is talking with the distant instructor and/or the picture of the atmosphare/situation of the classroom.

In order to take and to send these pictures in the classroom, two camras are contained in a Package System and are focusing to the students. Two additional cameras are equipped in a classroom. They are a document camera and a studio camera. Among these four channels of video from the four cameras, two channels of video are selected which can be displayed in the monitor TV in the Package and transmitted uplink to the satellite for broadcasting as return video and audio. The selection of video sources and pan-tilt-zoom of the cameras are easily operated by using the desktop control panel by a classmaster during a class.

A typical classroom is equipped with two 70-inch video projectors to display the picture of the instructor's face and course materials respectively from the Studio/Center Classroom, or the face of distant student who is talking with the instructor via satellite and/or the image of EB simultaneously. The life-size pictures of the instructor and the students enables to give the participants most vivid presence.

In addition to these video equipments, a Student Request Pad(SRP) with a microphone is located on each desk.

In order to keep good visibility of the video screens, the lighting is specially installed not to cause glare on the video screens. And the acoustic environment of the classroom is carefully designed to eliminate echoes and howlings and to keep good performance of the echo canceller. Because of these treatment, students in a NESPAC classroom feel more comfortable than in a traditional classroom.

5. THE NESPAC CLASSES AND THEIR TYPES

5.1 THE NESPAC COURSES

We have many educational programs provided by NESPAC which cover EDP systems engineering, software education, management education, technology education, sales education, etc. Some of these courses are just transferred to the NESPAC ones from the conventional classroom education using OHP, chalk and blackboard and some course materials are not suitable for video display and they are not so NESPAC-oriented.

As for the type of class, lecture with Q & A session type are frequently used for management, technology, and software education. Most of this type of courses are delivered from the Center Classrooms, while some of them are delivered from one of the Satellite Classrooms that is convenient for the visiting instructor.

Discussion oriented classes are often used for technical skills, software management, etc. Sometimes panel discussions are held by using the NESPAC. In this case a coordinator is usually at a Center Classroom, and panelists and audience participate at their most convenient Satellite Classrooms. The coordinator controls easily the progress of presentations from the Satellite Classrooms and discussions among them by using the Studio Pad.

5.2 SATELLITE BUSINESS COLLEGE

One of the NESPAC-oriented courses is called "Satellite Business College(SBC)" which has started from October 1989. This course has been developed on the concept of unifying "satellite", "business", and "college". And it will have several courses including marketing, software, technology, and management. The marketing course of the SBC has the following characteristics:

- It provides basic and practical sales education by the originally designed curriculum.
- The students can participate the class at their most convenient Satellite Classrooms among ten sites located across the country.
- The discussions through face-to-face like communications with two-way video and two-way audio between classrooms as well as the discussions within the classrooms can enhance and stimulate the mutual information exchange and development among the students.
- An area specific sales strategy can be lectured and transmitted from the appropriate NESPAC site by an expert of the area marketing and shared by the students in all NESPAC classrooms.

The courseware for the SBC Marketing course are developed in close cooperation with the instructors in order to increase the interactiveness between the instructor and distant students as good as in the Center Classroom where the instructor and the students are facing each other. It uses mainly discussion-oriented class including case method, role playing, etc. as well as lecture with Q & A sessions.

6. EVALUATION OF NESPAC

6.1 STUDENTS REACTION

Students can ask questions and receive answers from the instructor as if they were in the same classroom. And student evaluations indicate that NESPAC classes compares favorably with traditional classroom instruction because of the increase of students motivation to participate in the classes rather than just to attend the classes.

In early days of the NESPAC, a students' survey was conducted, and the reaction as a whole was favorable. For example, one question on the questionnair was, "How do you assess this system?" The answer was on a scale with 5 ranks, and an average score of the evaluation merits turned out to be a good score of 3.95. Another question, "How do you like taking classes in a Satellite Classroom?", got a score of 4.32.

The degree of the students satisfaction to the NESPAC classes was compared with traditional collective classes for one of the courses of management education programs. In this case the students are newly promoted managers who have cleared the qualification for managers, so that we can assume their characteristics are homogeneous in the sense of statistics. The assessment proved that the traditional classes got a average score of 4.2, while the NESPAC classes 4.27.

As for the case of the SBC Marketing course, sixty students attend the Center Classroom facing with the instructors and eighty the six Satellite Classrooms. In this case, a lecture-oriented class got a average score of 4.14 with Center Classroom 4.2 and Satellite Classroom 4.1; a role-playing 4.24 with 4.3 and 4.2; a case method 4.34 with 4.4 and 4.3. The fact that the difference of the scores between the Center Classroom and Satellite Classrooms was very small, proved the NESPAC classes to be almost media transparent.

6.2 COST-BENEFIT

One of the most important measure to evaluate a system is the cost-benefit. The benefit of the NESPAC based education can be summarized as follows:

- Reduction of travel time and expense to receive and/or to deliver education
- Increase of educational productivity (measured by student-days)
- Increase of educational opportunities
- Improvement of quality of education through using NESPAC media

The major cost factors due to the operation of the NESPAC include leasing the very expensive satellite digital lines and terrestrial lines, repayment for the NESPAC installation, rentals of floors, and the system operations and maintenances. The total of these costs is pretty expensive but the savings of the travel cost and increased student-days has almost compensated the cost.

7. CONCLUDING REMARKS

The NESPAC, a multipoint networking and simultaneous two-way communications via satellite, has successfully eliminated the difference of opportunities to access educational information. It has successfully realized all participating employees possible to send information from their own sites.

Being coeval with business expansion, the NESPAC, backed by state-of-the-art C&C technologies, have enabled NEC to greatly develop human resources in terms of quantity as well as quality, which had been a significant problem previously.

As a result of this success, NEC will continue to develop and expand the NESPAC.

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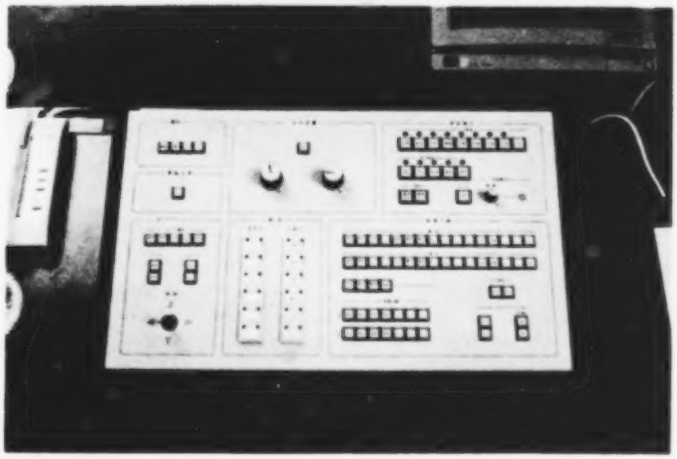
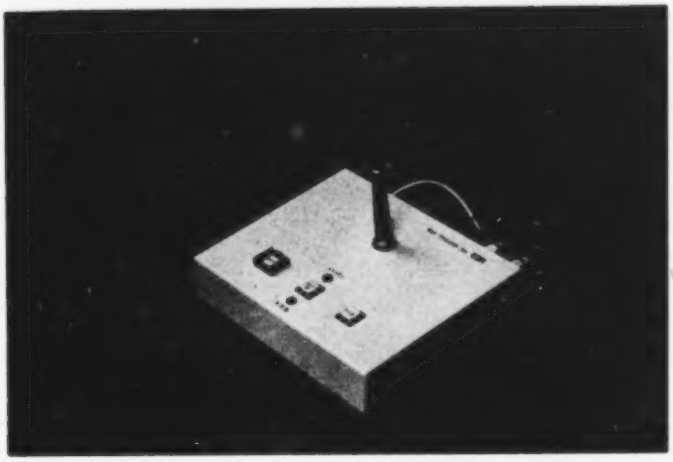
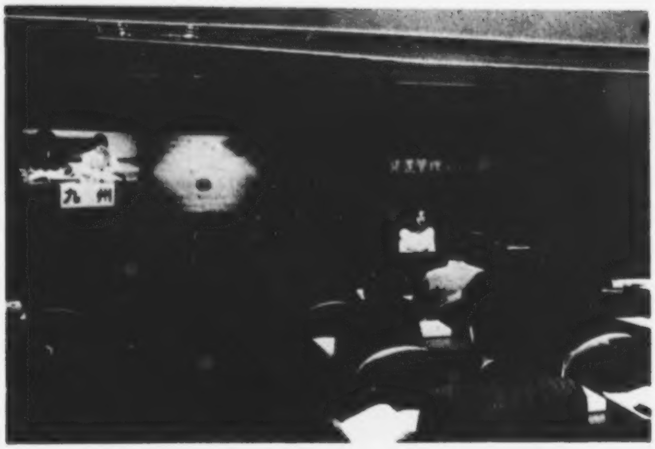


PHOTOGRAPH 1. STUDIO PAD



PHOTOGRAPH 2. STUDENT REQUEST PAD WITH MICROPHONE



PHOTOGRAPH 3. A CENTER CLASSROOM IN THE TOKYO SATELLITE EDUCATION CENTER

PHOTOGRAPH 4. A TYPICAL SATELLITE CLASSROOM

Designing Appropriate Instruction for Teletraining to International Audiences

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Abstract

This paper describes an approach to designing appropriate instruction for teletraining to international audiences. Though applications of international teletraining are relatively recent and sparse, the potential for the use of this form of training and education is vast. International teletraining that relies on instructional design principles and adjusts to specific cultural norms lends itself to a powerful and highly interactive form of instruction that can reach learners worldwide.

1 Introduction

As movement toward regional integration is developing in Europe and North America, the potential for international business and trade is increasing, along with an increase in the opportunities for sharing education and training programs. Teletraining offers the possibility of reducing the disparity between the more and less industrialized countries by communicating both technical information and expertise in a timely and cost-efficient manner. Teletraining (the use of teleconferencing for education and training purposes) is done internationally by corporations with an international presence and by educational institutions to exchange information and increase awareness. To avoid "cultural invasion" by the donor country and increase the chances for equalizing information and expertise via teletraining, those who provide either training or financial and technical assistance must learn the ways that their international audiences can learn best.

1.1 International Teletraining Models

International teletraining is defined as education and training over telephone lines to learners in another country. This kind of instruction occurs in a variety of ways:

- teletraining from North America to learners in other countries (AT&T in the United States currently provides teletraining to clients in other countries [Chute & Shatzer, 1989])
- financial and technical assistance from the more industrialized countries to less developed countries, which may then develop and deliver their own training (the Academy for Educational Development/U.S. Agency for International Development [AED/USAID] established ongoing teletraining projects in Peru, the Caribbean, and Indonesia [Tietjen, 1987]; Japan's Official Development Assistance program provided financial and technical assistance in telecommunications to 15 developing countries in 1988 alone, valued at 50 billion yen [A new trend…, 1989]).
- exchange of teletraining between institutions in North America and other countries ("institutional twinning") (Tufts University in Boston and Moscow State University in the Soviet Union developed ongoing "space bridge" seminars on issues of common interest, such as arms control, the environment, and the international economy [DeLoughry, 1988; Levine, 1988]).

1.2 Problems of International Teletraining

Countless books and articles have addressed the general area of instructional design (e.g., Gagne & Briggs, 1979; Dick & Carey, 1985), while a few authors have produced works on instructional design in distance education (e.g., Parer, 1989; *Writing for distance education*, 1979; proceedings from the 1982 and 1988 conferences of the International Council for Distance Education [Daniel, Stroud, & Thompson, 1982; Sewart & Daniel, 1988]). The literature is sparse, however, in terms of the design of instructional materials for distance learning in international settings.

This dearth of publications points to a short history and a corresponding lack of knowledge of a somewhat underdeveloped field. The international trainer in a highly technological country like the United States differs from learners in other countries in terms of resources, levels of technology, cultural background, and expertise (Murphy, 1988b). This paper gives information about cultural differences that impact the ways in which people learn.

1.3 Forms of International Teletraining

The delivery media used in teletraining to international audiences are the same as those used for domestic purposes. They are: audio, audiographic, and video teletraining, and computer-mediated communication. Although these delivery systems are sometimes used separately, the combination of systems lends force and sophistication not available when only one medium is used.

2 *Instructional System Design for International Teletraining*

Instructional system design is a systematic decision-making process for prescribing the optimal approach to attain specific outcomes under given conditions (Reigeluth, 1983). Traditional western-based models of instructional system design (e.g., Gagne & Briggs, 1979; Dick & Carey, 1985) generally include the following phases: analysis, instructional design, instructional development, implementation, and evaluation. Each of these phases will be described in terms of international teletraining applications.

The consequences are grave indeed for using traditional instructional design practices to prepare materials for international teletraining. Such factors as the educational system, the political situation, religion, communication patterns, and management styles play a significant role in the ways that individuals learn. If designers ignore these factors, students may resist learning. Alistair Stewart (1985) warned that technology transfer from a Western to a non-Western country may fail if instructional technologists use a "cookbook" approach to instructional design--based on western textbooks, knowledge, and practices--rather than adapt to the local situation.

3 *Phases of Instructional System Design*

3.1 *Analysis Phase*

The analysis phase normally consists of an assessment of the instruction, the needs and characteristics of the learners, the task to be accomplished, and the local resources. Traditional approaches to needs assessment, which include interviews, observations, examinations of records, surveys, and meetings may not be possible, may be inappropriate, or may even be omitted in international settings (Rossett & Saba, 1986).

Participatory needs analysis should include an analysis of the potential for local participation, the level of local participation, and ways to provide for the assessment (Kerr, 1982). A needs analysis in some cultures must also take advantage of the informal hierarchy: "There is a way to find out about people's needs (in the Philippines)...go to the market and listen and learn" (Josephine Majul, as reported in Gueulette, 1986, p. 13).

A recent teleconference between the U.S. and Turkey demonstrates what may occur when needs assessment is either inadequate or missing (Murphy, 1988a). The teleconference itself was the result of a carefully-planned partnership between the Turkish government, private industry, and higher education. The author, who planned and implemented it, was the only one who had an initial stake in its success. As a result, teleconferencing has not been used for distance teaching purposes since then. Only when one or more of the Turkish institutions identify their own needs and recognize that teleconferencing could effectively meet those needs will the medium be used to deliver instruction.

3.2 *Instructional Design Phase*

The phase of instructional design for teletraining to an international audience requires the course designer to prepare course materials that are appropriate for learners in terms of both content and process. Instructional design normally creates a plan, or "blueprint" that includes the determination of learning objectives and instructional strategies along with the selection of forms of media and testing. Instruction should be:

- Effective (it achieves the objectives of instruction)
- Efficient (it achieves the objectives efficiently--measured in terms of time and money)
- Appealing (it motivates the learners to learn) (Reigeluth, 1983)

Cross-cultural studies (e.g., Cole & Bruner, 1971; Scribner & Cole, 1981) have shown that cognitive development is determined by the environment in which a person is raised. Thus people will excel in areas that are important to them and that they are accustomed to doing. Instructional strategies that vary significantly from those typical of a given culture may therefore be rejected in international teletraining applications. When teletraining to American audiences, designers may select from a wide variety of strategies to attain the learning objectives and provide for optimal communication flow. These strategies include the traditional lecture in addition to such interactive strategies as case study, role playing, brainstorming, question and answer periods, and group work sessions (e.g., Parker, 1984; Monson, 1978). Many of these strategies would be inappropriate, however, for international audiences whose cultural values do not support interactive learning.

Role-playing, for example, which is known to have a powerful persuasive impact on Western learners (Fleming & Levie, 1978), may be an unacceptable form of instruction in cultures where it is not normally used. In an attempt to transfer a western management education program to Asian managers, role-playing was found to be ineffective, because the experiential learning model based on Western conceptions of adult learning opposes Asians' accustomed way of learning from their instructors, whom they hold in high esteem (Smart, 1983).

The "tyranny" of the examination system that exists in both developed and developing countries (Cookey, 1976) forces students to learn by rote rather than apply their knowledge to problem situations. Japanese managers, having been educated in a rote learning mode, would be unlikely to learn effectively if asked to do a problem-solving activity in front of their colleagues.

A top-down hierarchical form of decision-making found in many countries determines whether or not a teleconferencing medium will even be accepted. The officials at the top of the hierarchy may approve of the technology or may be apprehensive that it will interfere with existing cultural patterns. In India, for example, the village headman and the accountant are very powerful, and their power derives at least in part from the information they possess. If others are to have access to the same information, their own importance may be diminished (Bhalla & Jequier, 1988). Equal access to information tends to equalize power situations and upset the status quo. The authoritarian form of top-down decision-making typical of many countries could impede the adoption of teleconferencing, where all participants in remote rural areas would benefit from the same information.

The characteristics that distinguish one culture from another thus determine the design of instructional materials and the selection of instructional strategies. These materials and strategies must not only be based on realistic learning objectives but also include teaching techniques with which the learners are familiar.

3.3 Instructional Development Phase

Instructional development consists of the production of the materials, including study guides and instructor's guides. As effective teletraining relies in part on the designer's capacity to incorporate visual materials appropriately into the instruction, designers must adhere to cultural norms of color preference, direction of reading and scanning, use of symbols, and perception patterns.

It is known that the manner in which learners read and write and accordingly scan pictures varies from one culture to another (Goldsmith, 1984). In most Western cultures, verbal messages are perceived as proceeding in a left-to-right, top-down direction. Learners in cultures that normally read from right to left, however, may find it difficult to understand a teletraining instructor who presents and illustrates graphical information in the opposite manner.

A study informally known as "Dinosaur Noses" demonstrated that Western subjects required longer to understand information that was presented in an unexpected manner. Those who saw the time line in Figure 1, in which information was presented in a normal pattern (i.e., left to right, top to bottom, and superordinate categories presented first instead of last), responded more accurately and promptly than those who saw the time line in Figure 2, the reversed-diagram (Winn, 1983; Winn & Holliday, 1982). Although the subjects in the study were able to "learn" a new scanning procedure with repeated learning tasks, learners in teletraining classes who must pay close attention to the content being presented are less likely to have the opportunity to relearn their scanning procedures.

That study pointed out the advantages of presenting information in the way that is most meaningful to learners. What happens when materials are presented in ways opposite to the accustomed practice? It is significant to note that, while most Asian languages are read vertically, from top to bottom and from right to left, literate Chinese are accustomed to reading text and graphics in a variety of directions, at least since the Cultural Revolution. The sequence of the four cartoons in Figure 3 reflects the traditional pattern (top to bottom, right to left), while the two writing styles in Figure 4 (vertical writing above the cartoon and horizontal writing under the drawing) reflect the variety of patterns currently found in Chinese publications. This variation would indicate that literate Chinese may understand a teletraining instructor who presents and illustrates graphical information in the Western manner, once they understand the "code" of presentation.

In all cases, the materials must reflect the culture's color preferences, symbols, and patterns of reading and perception. Involving an individual from the host culture in the development phase of the instructional materials can minimize cultural misunderstandings and misrepresentations.

3.4 Implementation Phase

This phase, which is the first direct contact between the instructor and learners, is concerned with the implementation of the plans made in the design and development phases and consists of the delivery and management of the instructional program. Teletraining delivery problems are compounded when the audience doesn't speak the same language as the instructor, may be located on the other side of the world (it may be midnight for such a class), and brings to the situation a diverse set of culture-bound learning styles and beliefs.

The teletraining instructor must maintain a level of formality, timing, and credibility in keeping with the cultural expectations of the international audience. Differing expectations of formality may impede learning. Americans often have an informal delivery style, which includes calling students by their first names and expecting that they will do the same. The Japanese, on the other hand, address everyone by their last names, except those with whom they are most intimate, and they find the use of first names presumptuous and threatening (Copeland & Griggs, 1985).

International teletraining delivery is also influenced by what Geert Hofstede calls "power distance"--the extent to which a culture accepts unequal distribution of power. Many Eastern cultures accept that power-holders are entitled to special privileges (Hofstede, 1986). Power distance is compounded in Japan, where "saving face" is also a basic cultural characteristic (Kennedy, 1985). In Japan, therefore, a demonstration of greater ability or knowledge than one's superiors would be considered inappropriate behavior. AT&T training experts suggested that to avoid such an awkward situation, teletraining instructors should direct their questions to or through the ranking member of the remote audience (Chute & Shatzer, 1989).

The international teletraining instructor is integral to effective learning. Delivery strategies must reflect not only cultural norms such as levels of formality, power distance, scanning procedures, and language nuances, but also individual learning styles, needs, and background.

3.5 Evaluation Phase

Instructional evaluation is concerned with understanding, assessing, and improving the design, development, and implementation phases. Evaluation instruments must be reliable (measure what it is intended to measure) and must provide valid results.

Those who have conducted cross-cultural evaluation studies (e.g., Patton, 1985; Cuthbert, 1985; Seefeldt, 1985) suggest that evaluation is a culturally-bound activity requiring that the methodologies and categories reflect cultural norms and practices. Foisting western practices (like evaluation methodologies, models, and categories) on other cultures will likely result in faulty conclusions and cultural bias. Qualitative evaluation (e.g., Miles & Huberman, 1984; Lincoln & Guba, 1985), which includes personal interviews and participant observation reflects the strong oral tradition of many developing countries (Cuthbert, 1985).

In many Eastern and Middle Eastern cultures, where a high value is placed on politeness, concern for the feelings of others, and saving face, learners are unlikely to criticize or evaluate the instruction. Evaluations "simply aren't done...in cultures where the only word for 'no' is 'yes'" (Wigglesworth, 1985).

An example of a successful evaluation is one that Florida State University conducted for Radio Santa Maria in the Dominican Republic. This evaluation was successful primarily because it was participatory and involved an analysis from the U.S., on-site observations and reviews, and briefing and debriefing sessions (Mayo, Green, & Vargas, 1985).

Culturally-sensitive evaluation must involve those from the local culture in both the selection of evaluation methodology and categories and in administering the evaluation itself.

4 *Conclusion*

Teletraining will not work in all international situations. Costs may be prohibitive, the technological support may be inadequate in the receiving country, or the medium may be impractical for a variety of reasons. In most countries, national digital networks are inadequate for teleconferencing. Kathleen Hansell (1988) noted that the costs of international satellite video conferencing to Europe can be ten times that of local (U.S.) programs. Additionally, in those countries where a single telecommunications organization exists, transmission costs may be too high to justify any form of teleconferencing.

Until expert systems can design instruction that will respond to individual differences, instructional designers cannot provide adequately for the vast heterogeneity among distance learners. International teletraining, which must additionally take into account a host of cultural issues, is even less likely to respond effectively to individual and cultural needs.

It is possible, however, to arrange for optimal learning in international teletraining settings. A reconceptualization, or "reinvention" (Gueulette, 1986) of the instructional design model--one based on principles instead of traditional practices--is likely to increase the chances for successful international teletraining. Optimal exchange of courseware may occur in twinning situations, like the spacebridge linking the U.S. and the Soviet Union. International linkages must take into consideration regulatory and technological specifications, along with a variety of political, cultural, and educational issues (Figure 5 outlines some of the cultural issues). Where Western notions of individualism and Eastern motivations of collectivism and harmony may collide, appropriate instructional design for international teletraining depends on an adherence to sound instructional design principles and specific cultural norms.

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FIGURE 1: LEFT-TO-RIGHT, TOP-TO-BOTTOM SEQUENCING

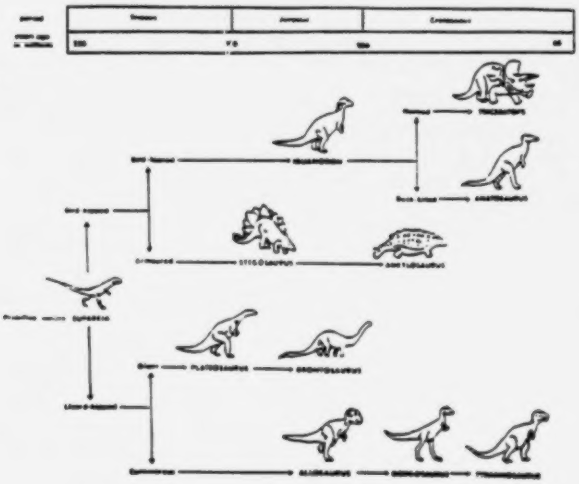

FIGURE 2: REVERSE-ORDER SEQUENCING

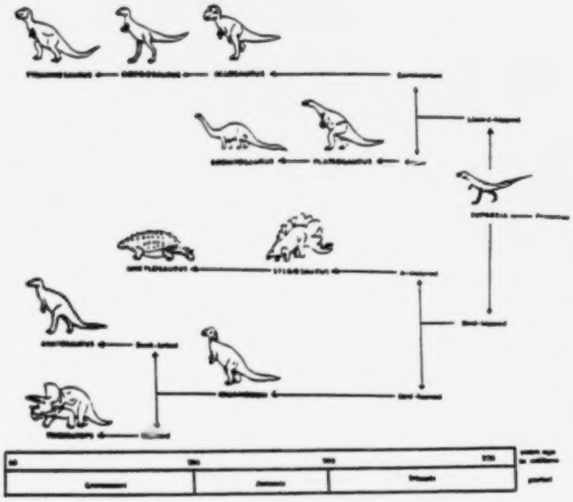

FIGURE 3: CHINESE CARTOONS WITH THE TRADITIONAL SEQUENCE

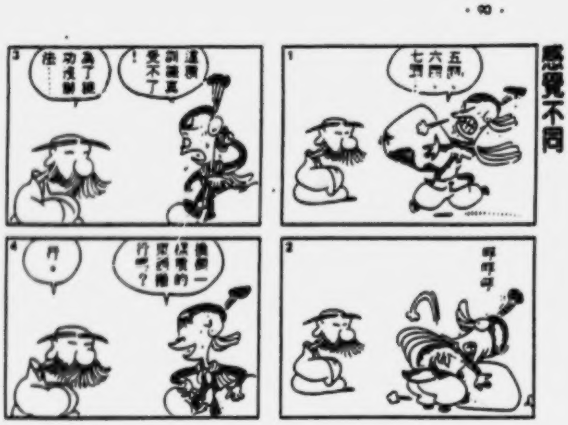

FIGURE 4: CHINESE CARTOON WITH BOTH VERTICAL AND HORIZONTAL WRITING

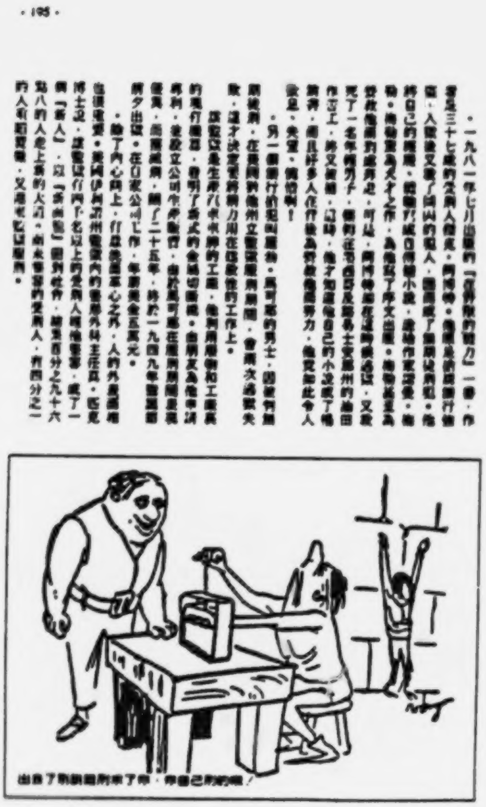

FIGURE 5: CULTURAL GUIDELINES FOR INTERNATIONAL TELETRAINING

Challenge ethnocentric assumptions that your way is the "correct" way to do something.

Reconceptualize the traditional instructional design model.

Enlist the aid of a local expert in designing and developing teletraining instruction appropriate for that culture.

Conduct a culturally-appropriate needs assessment.

Provide an interpreter for those who aren't fluent in English.

Design appropriate graphics and written materials.

Speak slowly and clearly, using short sentences with active verbs.

Conduct a participatory culturally-sensitive evaluation.

Use culturally-appropriate questioning strategies and evaluation techniques.

Avoid idioms, jargon, slang, and humor.

Don't foist Western standards, values, and models on learners.

Don't use such interactive strategies as direct questioning, role-playing, and brainstorming where they would be unacceptable.

Don't offer multi-point teletraining in different cultures indiscriminately.

COMPUTER MEDIATED COMMUNICATION AND HYPERTEXT:
BUILDING STRUCTURE INTO DISTANCE SEMINARS.

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Distance Education is moving towards the use of interactive, participative methodologies, that allow for student-initiated queries and discussions, as well as pre-planned system-generated instructional sequences. Computer-mediated Communication (CMC) is seen as one method of promoting this trend. The paper reviews current research on CMC and describes some attempts to use existing electronic mail networks as a medium for seminars at a distance on graduate courses. Some of the problems encountered in this experience have led to attempts to provide participants with an easy to use and learn structured environment for participating in the seminars. Initial results are promising and further development of the systems is planned.

1. DISTANCE EDUCATION: TRENDS TOWARDS TWO-WAY INTERACTION AND INITIATION OF DISCOURSE.

Distance Education is as old as communication media themselves. St. Paul did much of his teaching of scattered groups of converts by means of letters: the famous epistles to the Romans, Corinthians and so on. We can deduce from their content that two-way communication was occurring, that both parties (teacher and taught) could instigate topics of discussion and that the discussion could develop in directions that become relevant to the participants, rather than being totally pre-planned and "carved in stone." We are not sure how this two-way commuication system functioned, or how fast was the feedback, but it is interesting that this early example of distance education was interactive.

More than a century ago, in Victorian England, correspondence education was a thriving industry. The popular magazines carried advertisements of correspondence courses as they do today. The course materials were printed, but tutor-student interaction was encouraged and probably took place mainly by LONG, handwritten letters - this was the age of letter writing. Most of the materials were distributed by post, in chapters or modules - a characteristic of for-profit correspondence education to this day. As such systems grew in size and number, the interaction between students and tutors diminished and was formalized as system-generated assignments.

In this century, other mass media have been harnessed for educational purposes. Radio was the first of these, being used as the basis for several early, publicly-owned distance education systems. In the 1930's in Brazil, Roquette Pinto promoted the use of radio, on a large scale, for basic instructional purposes. His experiences showed, quite categorically, that radio has limited effectiveness as an instructional medium when students listen individually, but can be very effective indeed when groups of students gather together to listen and then to discuss, practice or otherwise use the content of the broadcast. Much of the learning occurred because of student-initiated activity.

In the last twenty years, use of mass-communications-based distance education has grown exponentially. Many millions of students, at this time, are studying at least part of the time by distance methods. Both the number of mass media employed and the number of ways of using the media have increased. The 1970's can be characterized as the decade in which the "Open University" of Great Britain formulated a model that has become widely disseminated in many countries. By and large, however, these systems offer limited opportunities for tutor-student interaction, less still for student-student interaction and are not at all designed to promote student-initiated learning.

In parallel with this development, there has been growth, in relatively small-scale projects, of mass-media-based, two-way instructional systems. These use a variety of systems, typically two-way audio teleconference, one-way television with two-way audio, one-way television and multi-way audio interconnecting a number of sites, two-way television, etc. A variety of supporting media are used for enhancing the feedback and interaction: audiographics, slow-scan television, fax, etc. These systems have typically been small because of the relatively high transmission costs associated with them. But this small scale has other implications and potential benefits:

being smaller in terms of total student number, less can reasonably be invested "up-front" in the preparation of materials, so more reliance must be placed on the process of communication and interaction among the participants; being smaller in terms of group size, it is possible to promote a discussion/participation mode of learning rather than the exposition/reception mode promoted by the larger systems. The use of such systems has grown very rapidly in the last decade, despite the relatively high operational costs of some of them.

With the advent of new telecommunications technologies, fiber-optic-based ISDN transmission systems and, particularly, computer-mediated-communication, we can expect further and more rapid growth in the use of such "participatory" distance-education systems. Current costs are expected to diminish significantly. Distance, however large, will cease to be a technical or an economical limiting factor. The type and format of the information to be transmitted (text, speech, graphic, video) will not pose technical barriers. Finally, the time-barrier will be overcome through the asynchronous nature of computer mediated communication made possible by the digital storage of transmitted information.

2. COMPUTER MEDIATED COMMUNICATION

Computer Mediated Communication (CMC) first became a reality in the early 1970's, as a result of the "marriage between computers and telecommunications" (Toner 1983). Its first manifestations were in the form of electronic mail (e-mail!) systems and a variety of bulletin board services, mainly serving the business community. Soon, multi-user conferencing systems were being used by some progressive corporations, but it was not until the early 1980's that significant use started to be made of such systems by the educational sector (Katz et. al. 1987). There are ever more CMC projects, of an ever increasing variety, including computer-mediated information exchange networks, computer-conferencing networks and computer-supported cooperative work networks. Many additions or subdivisions could be added to this simple taxonomy. Interest in CMC as a topic for research and development has also been growing, as witnessed by the rapidly increasing body of literature and the number of specialist conferences and symposia.

The potential of CMC as a methodology of instruction holds particular promise for distance education. The value of conferencing systems as a social communication medium among distance students has been demonstrated by many recent and ongoing projects, for example the Open University in Britain used the CoSy system on a foundation course throughout the 1987/88 year (Bates 1988; Kaye 1988; Mason 1988). However, this and many other projects have also demonstrated that the harnessing of CMC systems to the achievement of specific educational outcomes, requires careful design and implementation (Davie 1988; Lauzon et. al. 1989).

The asynchronous nature of the communication process in CMC, has been found of educational value in interactions between persons who are prevented from meeting face to face by distance. At Syracuse University we have, for some time, been supplementing classroom discussions by extended electronic mail interactions between students who are resident on campus and others who live further away. We have found that the e-mail discussions are often much deeper, much richer and involve a larger proportion of the student group than is typical in a conventional class-based discussion (Grabowski, inpress). However, we have also found that the use of e-mail as such a discussion medium poses certain challenges to the instructor. Notable among these are keeping control over the direction of the discussion and helping participants to maintain an overall view of the structure of the debate, as it evolves over time. Several instructional strategies for dealing with these challenges have been experimented (Romiszowski & Jost 1989).

The British Open University offers numerous multi-media distance education courses aimed at large numbers of home-based students. The Open University has integrated the use of the CoSy conferencing system into one of its courses (Mason 1988; Kaye 1987). Integrating computer communications is seen as a vital and exciting component for students to gain practical experience of the social and technological issues discussed in the course materials. However, the major value of CMC, from the students' viewpoint, has been found to be the informal interaction between students on a variety of topics, only some related to the mainstream course objectives (Bates 1988).

The Ontario Institute for Studies in Education, located in Toronto, Canada, uses the OISE's Participate System (PARTI for short). They offer off-campus courses, supplement distance education courses, and are experimentally offering courses that are solely CMC.

There are many smaller CMC applications on campuses and even in the secondary school systems. For example, the New York State Educational System supports several dozen small CMC projects which involve the linking of just a few institutions, or even the different sites of one institution. These projects utilize the State's own network called NYSERNet to link one institution's computers to another's (Benson 1988). On our own campus, at Syracuse University, both the CoSy and the PARTI conferencing systems are available on the mainframes and are being used as component media for several regular graduate and undergraduate courses, supplementing the normal "place-based" instructional activities. In addition, other courses (the ones described later in this paper, for example) utilize one or other of the three electronic mail systems currently installed, as supplementary media.

3. THE WHY AND HOW OF CMC

There are many benefits claimed for using computer mediated communication in education: a democratic environment for group interaction and learning; a record of the entire course; students don't miss any of the instruction due to absenteeism or daydreaming; more students respond to questions and ideas; the responses are longer and more complex than in a traditional classroom; the students learn from each other; teacher comments become more interactive (Romiszowski & Jost 1989).

There are also problems that need to be addressed when using CMC as an integral part of a course. Some of these spring from the asynchronous qualities of the communication process. This offers the above mentioned benefit of allowing one to think out a more structured, more complex response, and the benefit of being able to participate at times that are personally convenient, but can also generate communication difficulties such as procrastination and, perhaps in some cases, failing to respond altogether. Another problem is that students may, at any time, be inputing comments related to different stages of the development of the topic. Not only is the discourse "multi-level" in that several different topics may be in simultaneous discussion, but it is also "multi-speed", in that participants are responding to various phases in the evolving argument, at any one time. A lot of reading and rereading is required to keep a clear structure of the discourse in mind. (Romiszowski & DeHaas 1989).

A third problem originates from the distance communication aspect of CMC. Although distance communication allows one to participate in a discourse which may otherwise be impossible, it also introduces some difficulties of control of the discourse. The instructor loses some of the benefits offered by a face-to-face group situation. When the discussion drifts off the topic, it often takes longer, and is more difficult, to bring the group back on task. (Romiszowski and Jost 1989).

The relevance of the above mentioned problem-areas depends on the specific system and its purposes. CMC has principally been used as a conference system (hence the popular term "computer conferencing"). This implies that a group of individuals exists, who choose to debate a topic of mutual interest. They may be in search of new ideas and may view a change in the direction of the discourse, as a positive development. Keeping "on task" may not be an important factor as the task is not precisely defined.

Another common use of CMC is as an information system, as exemplified by the proliferation of bulletin board systems. Their primary purpose is to offer a special-interest-group information-sharing service. An example of this is the recently launched EDUCATIONAL TECHNOLOGY MAILING LIST. This was the idea of a group of graduate students and faculty at Michigan State University in February 1989. A variety of topics are being discussed; for example, a recent particularly heated and prolific exchange on the question of copyright of material that is put out on freely accessible electronic bulletin boards (Rosenberg and Banks 1989). Keeping a clearly structured memory of all topics under discussion is not an issue, as most people just look selectively for information that is personally interesting or useful.

Another way of using CMC for information dissemination is as on-line journals. This is an electronic equivalent to the conventional academic journal. It has the advantage of rapid publication and easy editing, updating, and also cooperative authorship of contributions by geographically separated authors. A further, and growing, use of CMC is as a social communication system. This use is of growing importance in distance education. It provides students with the opportunity of social interaction with other students, which is often a missing component in distance education. Neither of these uses suffer from the problems outlined earlier.

The main purpose of this paper is to examine the use of CMC as part of an instructional system. It is in this context that many of the advantages and problems discussed earlier are of greater importance and relevance to the designer of instructional systems.

4. EXPERIENCE WITH CMC FOR INSTRUCTION

Our own experience in the use of computer-mediated communication as a formal methodology of instruction commenced with a short computer-conference (or rather SEMINAR) which linked up two student groups on similar courses at the Universities of Twente (in Holland) and Syracuse (in the USA). I was teaching a course, while on sabbatical at Twente, which was examining the potential impact of new technologies on the practice of education and training. Computer-mediated-communication was one of the topics under analysis, and so it was natural to wish to get some first hand experience. At Syracuse University, a group of students, with similar interests, were already using e-mail correspondence to discuss assignments on one of their ongoing courses (even though they were meeting regularly in class sessions) and were interested in extending their experience with the medium.

Further stimulus came from the Conference on Computer-Mediated-Communication, held at the Open University in England in October 1988. It presented the Open University's first year experience with the use of CMC as a medium in distance education courses (Bates 1988; Mason 1988). This experience, probably the biggest so far (over 1200 students on a year-long course) illustrated, very clearly, the amount that yet has to be learned as regards the planning and execution of instruction via computer-mediated networks. The use of a purpose-designed computer-conferencing system (such as COSY or PARTICIPATE) did not, in itself, guarantee a successful and productive conference. The most important factor is what the users (both students and teachers) choose to do with the system.

My own interest was in using a simpler system (the existing e-mail linkup through Bitnet) but with a greater amount of structure to the interactions, that would replicate certain face-to-face strategies of instruction. It was decided to replicate the SEMINAR structure, as this would seem to be particularly suitable to the characteristics of the system. Accordingly, a short (5 page) seminar paper was prepared and circulated to all prospective participants. At the same time a common LISTSERVE file was set up on the two universities' e-mail systems, to enable the messages of all participants to be routed automatically to all other participants. A time-frame of one month was set for the discussion of the paper, to culminate in a live telephone conference/discussion set for late November 1988. The structure of the initial paper was carefully planned to focus attention on a relatively narrow band of issues (or so we thought). The chosen theme was an analysis of the potential changes that may occur in the educational technology profession as a result of predicted changes in education/training brought about by the adoption of new communication/ information technologies (the title was: "instructional design and development in the age of computer science and information technology").

Rather surprisingly, the discussion that did take place was quite different from the intentions defined in the initial seminar paper. Rather than discussing the predictions made on the effects on our profession of greater use of new technologies in education/training, the participants chose to challenge the basic assumptions that new technologies will in fact have a significant impact. Whereas this is quite a valid and potentially useful discussion topic, it is interesting that the seminar should so easily have got diverted from its original goals. A retrospective study of the dynamics of the seminar suggests that the initial respondents to the paper, who chose to challenge the basic assumptions, then set the tone for the whole in that later respondents tended to reply to the latest messages on the system, rather than to a general framework for the discussion that was set up in a paper some way back in time.

Separate analyses of the structure of the discussion were performed, retrospectively, at both Twente and Syracuse, by different participants. One aspect of interest was that the structure was seen to be different by each of the analysts. One analysis performed at Twente, identified 6 main topics of discussion. Another, performed at Syracuse, identified only 4 main topics and only 3 of these were present in the Twente analysis. This finding illustrated the somewhat personal view that each participant developed of the seminar. Also, it was significant that the retrospective analysis of the total seminar content did not coincide with the impression that the same participant had formed while participating. All the analysts agreed that they were surprised by the simplicity of the structure that they uncovered in retrospective analysis - they all had the impression earlier on, during the seminar, that many more topics were being discussed and that the structure and dynamics of interaction among participants were much more complex than was in fact the case. This would seem to support the view that the characteristics of CMC create some difficulties for the participant to maintain a clear picture of the discussion, over time.

The observations described above were the basis for the planning of a second CMC seminar, held during the months of April and May 1989. This was planned to examine some of the earlier observed factors somewhat closer. Firstly, an attempt was made to generate a seminar topic that would be of intrinsic interest to the target group. Secondly, the seminar paper was kept much shorter than the one used on the first experience. The object of this paper was only to define with somewhat more precision the theme to be discussed. Thirdly, the planned time for this seminar was two to three months and the size of the participating group was to be larger. This would allow us to investigate how the problem of maintaining a coherent view of the seminar's structure, changes with the size of the seminar. In order to gather together a larger group of participants, an invitation was extended to several other universities that offer similar graduate programs.

The overall outcome of this second seminar was not at all as expected. Although a much larger group of potential participants was initially contacted, the number of actual participants who contributed specific content-related messages was smaller than on the previous occasion. Once more, however, this discussion rapidly drifted away from the expected theme initially defined for the seminar.

The sub-themes came so to dominate the discussion that other messages, somewhat more related to the initially selected theme, were largely ignored. As a consequence, several early participants dropped out of the seminar discussions, discouraged by the lack of response to their messages. Some of the early participants commented that as the discussion progressed and became more specialist, they became less able to contribute any comment that they would think others would be interested in reading. Some more vigorous moderation of the process may have kept these less confident participants "on board". In actuality, the moderation function was intentionally delegated to the students who set up the idea for the seminar. They took it the way they wanted to take it and, on the way, lost those who had expected to discuss other aspects of the topic.

In May and June of 1989, during the summer school sessions, a third attempt was made, this time imposing some more precise, course-related structure to the proceedings. A summer course on aspects of instructional design and development ws being taught. The participants of this course were to discuss a series of seminar papers on selected topics. Some of them elected to conduct the discussion of their papers, in part of in some cases totally, on the network, rather than in the normal face-to-face class meetings. The interaction on the CMC system was made part of the expected course activity, and was given some weighting in the course grading system. This approach gave much greater focus and purpose to the use of the e-mail system. For one thing, several class attendance sessions were traded for the electronic communication sessions. Students could focus the discussion of their paper to a very precise degree, by concentrating on one topic and by building in stimulus questions/ challenges for their colleagues to respond to. The ensuing debate was a much richer and deeper, as well as a much more focused experience. In addition, the depth and detail of this ensuing discussion compares very favorably with that usually obtained in a classroom based seminar session.

On the other hand, the style of contributions and their length has undergone a significant change. Whereas the messages on the previous occasions were generally short and chatty and directed to one or other of the recently preceding e-mail messages, the responses now became longer, more formal and precisely tied to specific points raised in the original paper. The seminar participants were responding by writing a carefully argued mini-paper, responding to a series of issues raised by the author. Furthermore, due to the very precise focus questions, supplied by the author in this instance, all the participants responded in a generally similar overall framework. The individual responses were, of course, separated in time over a period of some days, so it is probable that the later respondents had read the replies of the earlier ones before themselves responding. Yet there is very little comment on each other's viewpoints as compared to the immediate and personal reactions in the previous two seminars.

These differences have both their positive and negative aspects. On the positive side, the intensity of involvement and participation increased. Most participants replied with fairly long, multi-faceted arguments to the specific issues raised in the focus questions. Also, the discussion did not wander disastrously away from the topic initially set. In some eyes, of course, this focusing could be considered a negative aspect, in that it may have limited the exploration of "bright ideas" that were not foreseen in the original author's focus questions. But from an instructional design viewpoint, some focusing (more than was achieved in the previous two experiments) is generally desirable.

A more serious negative aspect is the length and formal structure of the responses. The task of reading, analysing and (particularly) comparing them, is similar to the analysis and evaluation of a set of term papers. In order to make any sense of the comments, one must have the original paper and the focus questions available for constant cross reference. Also the task of writing and inputting such a long message is not the most effective and efficient way of using an electronic mail system.

It is intearesting to speculate on the reasons for these changes in the use made of the e-mail system. To what extent did this happen due to the formal incorporation of the electronic discussion as part of the course methodology and grading system? Did participants suddenly feel obliged to write comments that had the appearance of an essay? To what extent was the extra precision of the set of "focus questions" responsible for the precision of the responses? To what extent ws the fact that in this case students are responding to one of their peers as opposed to the instructor, influential in changing their style? However, perhaps a more useful speculation would be to consider how the system could be changed to facilitate the positive and eliminate the negative aspects of response style.

Throughout this series of experiments, much attention was paid to the question of how a participant may form and maintain an overall structure of the discourse that is evolving over time. Several methods were used for keeping track of structure. Several students have been using the "notebook" approach available on our e-mail system, to store the seminar messages in a series of separate topic-files. One limitation of this system is that one cannot construct a hierarchical (or any other) structure of notebooks. Any complicated structure must be noted separately, off line. Others have preferred to print the messages, edit them and store them in a paper filing system, rather like notecards. This permits a certain amount of cross referencing but is time consuming to update.

It is in this context that a Hypertext environment, or shell, into which all messages could be stored in the most fully cross-referencable manner, suggests itself as a possible solution. Before proceeding to design and install a hypertext-based e-mail system, it was decided to test out the concept under simulated conditions.

5. HYPERTEXT AND ITS CONTRIBUTION TO CMC

In June of 1989, an opportunity presented itself to test our ideas in a simulated environment. Two courses were being taught that happened to involve the topic of hypertext. For the first, a conventional seminar structure was employed. One of the course participants prepared a lengthy and well referenced discussion paper on the topic. This paper quotes some 32 other sources of reference. The paper was circulated to participants a week or so prior to the discussion session. The ensuing discussion was lively and useful. However, in two and a half hours of discussion, only a small proportion of the issues raised by the author were in fact submitted to any discussion. Also, as is commonly the case, one or two of the participants tended to dominate the discussion, while others remained silent for most of the time. The resultant "added value" of the seminar session to the original paper was not very great.

A couple of weeks later, on another course, a modified approach was used. The same position paper was distributed to participants, but with cross-indexing to all other reference sources used, clearly marked in the margin. Further, the 32 sources actually quoted in the paper were collected together and cross referenced to the paper. In addition, a further set of basic reference materials were made available. The participants were set the task of reading and responding to the paper. In terms of outcomes, this task was identical to that set to the conventional seminar group. In terms of process, however, the task turned out to be quite different. All were expected to write their own "margin comments" and annotations to the paper, paragraph by paragraph (whenever they had anything to say, of course). It was interesting to observe the process in action. Most participants started with the intention of reading the paper as a whole, then going back over it to make their comments. However, they soon gave up this strategy as not productive, opting instead to adopt a non-linear strategy. A quick scan of the paper would identify the first point they found interesting or unclear. Some use would be made immediately of one or other of the cross-referenced original sources. A comment would be written. Sometimes, the quoted sources would themselves cite other sources which (fortuitously) could be easily accessed in the study center. These were added as further references by the discussants. As work progressed, cross links were sometimes indicated between comments made earlier and those now being made. Additional pointers would be added to clarify these links. Some two hours were spent (formally) on this analysis and annotation exercise.

In a final session, the participants (there were only 8) pooled their various comments, sharing them with the author of the original paper. The sum total of written comments totalled over twice the length of the original paper. The quality of the comments and additions was, of course, variable but the net "added value" of new ideas, points of view, or just information, which resulted, far outweighed that achieved in the conventional seminar session. Finally, the participants in this exercise were unanimous in stating that they felt they had gained much more in this form of exercise than they would have done in conventional seminar or reading-assignment-based exercises.

Such "collaborative creativity" is one of the tenets of the belief-structure of many Hypertext enthusiasts. Indeed, one particularly fruitful area of application for hypertext systems has turned out to be the collaborative authoring of literature (often fiction). The collaborative annotation of student papers by both faculty and students is also something that many proponents of hypertext advocate and (occasionally) practice. One of the more long-lived working hypertext environments - Intermedia at Brown University - was specifically designed to support this sort of collaborative educational activity (Yankelovich et al 1985, 1988; Landow 1987).

However, current hypertext systems which can support this type of activity effectively are large, purpose built systems, which are costly and not easily compatible across different computer systems. The Intermedia system is "built on top of the 4.2 BSD UNIX operating system and runs on IBM RT/PC and Sun workstations which support Sun's Network File System (NFS)" using a special version of the C programming language, and a host of specially developed applications packages (Meyrowitz 1986). Other powerful and flexible systems, such as KMS (Robertson et al 1981) or NEPTUNE (Delisle et al 1986) are quite different in configuration, but no less complex and difficult to network.

Our current projects are based on the concept of utilizing, as much as is possible, what already exists and is established in significant quantity in the educational marketplace. At this point in time (in USA universities at any rate) the MS-DOS personal computer has the largest market share followed by the Macintosh. Also, many existing e-mail systems operate as networks of existing general purpose personal computers. When used for e-mail, these computers are called on to act simply as dumb terminals linked to the mainframe that supports the communications system. However, it is possible to make use of the presence of local power and memory storage to download incoming mail messages to be stored directly on disc, rather than/in addition to hardcopy printout, or storage on the mainframe-based notebook system. It should be possible to adapt an existing pc-based hypertext environment so that new messages can not only be stored in appropriate subdivisions of the basic structure one creates, but can also be freely cross referenced to other relevant messages. We are investigating the applicability of some currently available and relatively cheap hypertext applications packages for this purpose.

A recent experiment involved the use of a networked communication space, set up in Hypertext and running on a MacIntosh cluster. Each of the participants in the CMC seminar has a stack of pre-prepared cards, with scrolling text windows, thus giving unlimited writing space, but dividing the text into "chunks", so that each seperate idea/topic in the discussion has its own card. These card can be accessed by all the participants, who can read them, add small anotations and make links to cards in their own stack. As the discussion progresses, a cross-referenced network of documents is created. This facilitates the review of the discussion by a new participant or by someone who has not logged on for some time. It also ensures that new comments are linked to earlier ones on the same topic, as well as making it very easy to review all the contributions of any one participant.

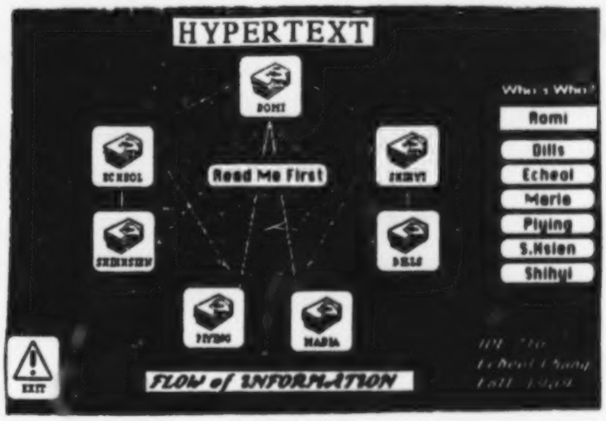
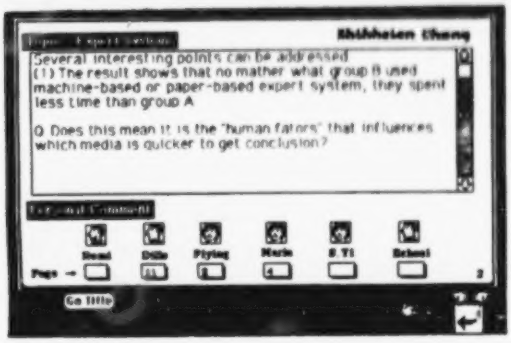


Figure 1.



Several interesting points can be addressed
(1) The result shows that no mather what group B used machine-based or paper-based expert system, they spent less time than group A

Q Does this mean it is the "human fators" that influences which media is quicker to get conclusion?

Figure 2.

Figure 1 illustrates the home card of the system set up for seven seminar participants. In addition to the seven personal stacks, users have available a short resume of each participant and their phone, fax and e-mail numbers, in case they want to get into touch personally, send a reprint of an article, etc. Clicking on the required icon takes one directly to the first card of that stack. Browsing through that stack, the reader can identify the specific topic under discussion by a label in the top left corner. Figure 2 shows a typical card from one of the stacks. The stack "owner's" comments, in this case on an experiment performed with an expert system, have in turn been commented by three other participants, who have registered the card numbers in their stacks where the relevant comments can be found, in the small windows below their personal icon. To read their comments, just click on the person's icon and key in the card number. To register a new comment, just type it into one of your own cards and create a cross reference by typing that card's number in your window on the other person's card. The system was designed by one of our students, Echeol Chang, specifically so that no learning of hypercard or any complex access commands would be necessary. People are comfortable on the system in a matter of a few minutes.

6. WORK IN PROGRESS

We are currently using this networked system on campus, in the computer clusters. It is intended to be a model for a system that could in future be accessed over telecommunication links from any distance. For the time being we are more concerned with investigating the value of such a structured communication system as compared to other alternatives and have not addressed the question of making it widely available. As the system is conceived as an alternative to e-mail or other readily available CMC systems, we are concentrating on the comparison of these alternatives from the user's viewpoint. During October/December 1989, we have been using several alternative structured communication systems: the system just described and a file-sharing system in which all participants comment a position paper in the same file, but do so by inserting their comments among other related comments. This can be implemented on existing mainframe systems, in our case in CMS. Users have access to a read-only initial file (the paper to be commented) and to a read/write comments file. These can be set up in two scrolling windows, on a split-screen, so that comments can be typed in as the paper is being read. Organization is achieved simply by referring comments to line numbers in the original position paper. This approach has the advantage that it is possible with already widely available systems, networked internationally through Bitnet or its alternatives. It has the disadvantage that it is clumsy to use and much learning is necessary to become skilled in use. Surprisingly, users do not have much of a problem with the interpretation or generation of comments that are mixed in with other users' comments in one document. We have therefore prepared a user friendly, MacIntosh equivalent of this sytem which we are currently testing in comparison to the networked system described earlier.

This study is ongoing and results are not available, but we are getting the impression that there may be not much difference in value and acceptability between the two approaches, though both are much superior to the unstructured, chronological list of contributions which result from the e-mail seminars that we described earlier in the paper. Future plans include further development of the structure of these systems and their comparisom with the much more sophisticated special-purpose conferencing systems such as CoSy and PARTICIPATE. Then we shall address the questions of wider dissemination of these systems, so that they may be used as seminar platforms in large distance education systems, as well as an additional medium in campus-based courses.

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SASKATCHEWAN COMMUNICATIONS ADVANCED NETWORK:
Distance Education Saskatchewan Style

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Abstract

A gestation period of five years separated conception and birth of the Saskatchewan Communications Advanced Network (SCAN). In 1983, Ministers of the Government of Saskatchewan were asked to appoint representatives to a Distance Education Committee. The Communications Policy Branch and the Distance Education Committee in collaboration with the Departments of Agriculture, Culture and Recreation, Advanced Education and Manpower, Education, and Saskatchewan Telephone conducted an extensive year long study into the communications needs of the province. Deliberations of these agencies resulted in the writing of a white paper which culminated in public hearings held throughout the province during 1984. One hundred and twenty-one presentations were received at ten hearing sites spread across the province. Strong public support was voiced for establishment of a Saskatchewan Communications Advanced Network. On January 11, 1989 an Order in Council created a new Crown Corporation to be known as the Saskatchewan Communications Advanced Network. The mandate of the new corporation was to ensure that virtually everyone in Saskatchewan will have *improved access to informational, cultural, agricultural, and educational programming* (SCAN, 1989, p.1). The specific mandate of the Corporation was *to provide equal access to information to all Saskatchewan residents*. The broad mandate was that, *in addition to the dissemination of public information, it will also promote the development of the communications technology and information industries in the province* (Hersche, 1989, p.1). This paper looks at the special nature of Saskatchewan's information delivery system in respect to the high degree of public input during its creation, the unique technical configuration of the network, and the participatory nature of programming to be carried on the network.

INTRODUCTION

Another milestone in telecommunications development in Saskatchewan was marked with the appearance of an Order in Council January 11, 1989 advising establishment of a Crown Corporation *to undertake the creation and implementation of the Saskatchewan Communications Advanced Network (SCAN)* (Gazette, 1989, p.18-129). This event signaled fruition of a decade long thrust to establish an equitable and efficient means to improve access to educational, cultural and informational programming. Throughout this same period the province of Saskatchewan systematically installed a world class telecommunications infrastructure including a sophisticated fibre optics network, telephone system and satellite network.

This paper will trace development of the Saskatchewan Communications Advanced Network from its initial roots to the present. A unique characteristic of the Saskatchewan approach has been the degree to which the residents of the province have participated in the decision making process. This process has consumed an inordinate length of time, and the jury remains out as to the efficacy of the approach. Another unique feature is the manner in which the existing infrastructure has been preserved and incorporated into the new mold. In a paper presented twelve months earlier the author concluded with this statement:

> *This paper describes a seven year segment of telecommunications development in Saskatchewan and the role that telecommunications has played in "Bridging the Distance" between the learner and the institution of learning. It provides a cursory account of some of the deliberations and experimentation that occurred in Saskatchewan as a new technology is interfaced with an old task. The Saskatchewan experience like its people has been cautious and deliberate. Although the results are not all in, the Uplink series and incorporation of STELLA, ppears to be serving the people of the province well. It is a model that bears consideration when designing a telecommunications system in an area with the geographical, population and financial situation of Saskatchewan* (Brown, 1989, p.462).

The model delineated in the previous paper has not been superseded by developments taking place in Saskatchewan over the past year. Rather the model appears to have been supplemented and strengthened - coming of age as it were. This process of maturation adds a new dimension to the potential for distance education in the province as it relates to telecommunications.

SASKATCHEWAN

One of ten provinces of Canada, Saskatchewan is situated between Manitoba on the east and Alberta on the west, Northwest Territories on the north and the United States on the south. Figure 1 shows Saskatchewan as it is located on the North American continent. It is an interior province sharing with Alberta the distinction of having no boundary adjoining salt water. Saskatchewan has a population of 1,009, 613 (1986) and a geographical area of 652,000 sq. km. (252, 000 sq. mi.) including 178,000 sq. km. forested land and 81,631 sq. km. of inland water. Population density is about 1.8 per sq. km. (4 per sq. mi.) and is concentrated in the southern third of the province. Climate is continental, with cold winters and hot summers. The topography ranges from semi-arid rolling plains in the south, through the central grasslands (grain belt), to rugged Canadian Shield rock, swamp and forest in the northern half of the province. Agriculture is the largest single industry with farm receipts making up $4.1 billion (1986) of a $17.4 billion (1986) gross domestic product. Other principal industries include manufacturing, mining, meat processing, petroleum refining, fishing, forestry and electricity production.

Elementary and secondary education in Saskatchewan is carried out by a system of Protestant and Roman Catholic schools. In 1988, 948 elementary and secondary schools served 203,866 students. Post-secondary institutions include nine regional community colleges with a non-credit enrollment of 86,000 students and two universities located in the largest cities, Saskatoon and Regina, serving 20,000 students. Four technical institutes in four separate locations across the province have 7,500 full-time and 21,000 part-time students.

Figure 1
SCAN PROVIDES COVERAGE FOR THE ENTIRE PROVINCE OF SASKATCHEWAN

PRIOR TO THE WHITE PAPER

A decade of development preceded the current implementation of SCAN. Although SCAN was formally initiated by a White Paper of the same name it may be useful to establish a historical perspective by commenting on selected events which led to distribution of that paper.

In the late 1970's Saskatchewan educators were becoming increasingly interested in the potential of educational technology as a solution to some of the concerns facing education. Population shifts and declining enrollments in the rural areas made it difficult for small schools to ensure quality of education and equality of opportunity. Pressure to increase qualification swelled enrollments of post-secondary institutions. Desire for delivery of vocational and university training to areas of the province not serviced by existing institutions was mounting. Realization that a need existed for retraining and for vocational upgrading was beginning to surface. Educators were beginning to take technological initiatives, establishing ad hoc pockets of technology in local jurisdictions. The technological imagination of the province's educators was fired by the installation of a fibre optics delivery system throughout the province. Telidon and satellite trials were under way.

Educators looked to the Department of Education for guidance as to the actual and potential uses of educational technology. In an effort to react to the increasing pressure to use technology in education the Department initiated a study entitled Communication Technologies in Education Project in May, 1981. A 14 person steering committee was established to provide *philosophical and practical direction for the project* (Sask Ed, 1983, p.5). This committee included participants from Communications, Education, Continuing Education, Culture and Youth, Agriculture, Sask Tel, Sask Comp, Sask Media, University of Saskatchewan and University of Regina. Three major objectives were studied:

•to identify current issues relating to the use of communications technologies in education.
•to identify situations where alternative courses of action are possible and to discuss the implications of each course.
•to suggest policy directions and courses of action for consideration by the Department of Education over the next several years. (Sask. Ed.,1983, p.6)

This committee concluded that:

In this report the educational potential of a range of communication technologies has been discussed. The technologies examined have included the traditional as well as the innovative.

It is evident that many traditional and emerging technologies can be beneficial in supporting the teaching/learning process. It is important, however, that various media be selected carefully and only used when they facilitate the realization of educational objectives or when they enhance the teaching program in some way. Technologies should never be used for their own sake.

In considering use of emerging hardware and delivery systems for distance delivery, accessibility to technologies becomes an issue in some rural areas. Equality of opportunity should continue to be a guiding principle in instructional support initiatives undertaken by the Department.

Because communications technologies are often high cost, consultative services and sometimes direct programming need to be provided at a provincial level. There are rapid changes taking place in development of hardware, software, and delivery systems at the present time. The Department of Education should continue to monitor educational needs and developments in the field of educational technology.
(Sask. Ed., 1983, p.33)

In respect to telecommunications the report specified:

...the implementation of a system for the delivery of additional hours of broadcast television requires further research and study. Since the options under consideration include broadcast, closed circuit, and cable television on a province-wide basis, negotiation with other government departments and provincial agencies is necessary. Such a system would be beyond the scope of one government department. To be financially viable the system would have to be a co-operative

project involving several agencies (Sask. Ed., 1983, p.32).

An outgrowth of the initial meeting of the communications technologies committeewas an agreement that a smaller working group meet to study the issues and develop a document which would be of assistance to all concerned with distance education. This group met without official direction from the organizations involved. The Provincial Distance Education Working Group was established in May, 1981, as an informal, co-operative venture to study distance education under the following terms of reference: *to determine the needs of user agencies;to determine the organizational, technical and software production requirements for successful implementation,;to identify feasible alternatives available to users; and to evaluate alternatives in light of cost data* (Benson, 1982, p.ii).

While not all intended objectives were realized the group concluded:

(1) Communications technologies have the potential to be a very effective component of learning systems.
(2) Introduction of innovative approaches to service delivery as typified by distance education must take account of a number of critical factors if the innovation is to be successfully adopted.
(3) The trend in distance education is toward individualized learning systems utilizing interactive communications technologies. Personal contact is also an important aspect of distance education systems.
(4) Software is to be considered paramount in a distance education system. The "content" is the key to appropriate utilization of hardware.
(5) Administrative and organizational factors must be given sufficient emphasis in planning adistance education systems.
(6) Communications technologies could be utilized as a means to expand upon and enhance the capabilities of each of the representative organizations to serve its client groups, by increasing the access of individuals to a broad range of opportunities along with access to communities of interest that would foster learning through interaction.
(7) Communications technologies must also be considered a part of culture and cultural expression
(8) Access to opportunities carries with it the implication for telecommunications linkages across provincial boundaries in cases where institutions or agencies might consort to develop and offer services or where clients require access to services beyond provincial boundaries.
(9) An organizing principle will be necessary and organizing structures should be in place. There was no consensus on the form of such structures, but simply a recognition of the diversity that will be required.
(10) Fiscal support will be necessary, either in the form of new funds or funds newly allocated as an outcome of strong policy decisions.

(Benson, 1982, p.ii-iii)

The group expressed a strong conviction that *distance education has tremendous potential for a province such as Saskatchewan with its social and geographic characteristics. They concluded that each of the representative organizations, and many others not represented, have a role to play in future development of educational communications services and might therefore begin immediately with action plans which will enable the province to enter the 1990's with appropriate delivery systems in place for the benefit of its citizens* (Benson, 1982, p.iii).

In order to begin this process of *developing delivery systems for educational and cultural purposes which will be consistent with the social context of the 1990's*, the Provincial Distance Education Working Committee recommended the following new directions:

(1) That the Government of Saskatchewan recognize the potential of distance education and modern communications technologies for the development of a wide variety of educational and cultural services to the province.
(2) That this recognition come in the form of systematic development of distance education capabilities, beginning with inter-institutional linkages and the establishment of learning centres at a distance.
(3) That the crucial need for software be recognized in any process of development.
(4) That the development of distance education systems be considered as an integral part of provincial industrial strategy.
(5) That a Task Force be formed with a mandate to initiate a planned program.
(6) That an outcome of the Task Force be an organizing principle for future network developments.

(Benson, 1982, p.iii-iv)

The working group met from July 1981 to March 1982 by means of teleconference. An interim report was completed in September 1982. A final comment in the report recommended that the Provincial Working Group be dissolved and replaced by a Task Force with official recognition and mandate to:

(a) develop a planned program of specific initiativs to be undertaken by interested organizations beginning with the 1983-84 fiscal year, or the soonest thereafter;
(b) develop an organizing principle in the form of a "Provincial Distance Education Network" for the development and delivery of services.

The group further specified the task by indicating that the "Network" recommended be defined *in both human terms, as the means to bring together and catalyze appropriate actors in the public and private sectors, and in hardware terms, as the communications highways and appropriate use of such highways in the public interest* (Benson, 1982, p.56).

A number of other agencies and institutions, public and private, were, during this same time period, contemplating their needs as anticipated by the new technologies and the fibre optics network. For the most part the majority of educational thinking is reflected in the work of the two groups mentioned above. Business and industry, although vitally interested in the potential of the fibre optic network for information transfer, tended to be complacent concerning the educational and training potential of the new technologies. A number of concurrent activities were initiated during the period following tabling of the reports from the Department of Education and the Provincial Distance Education Working Group. The Communications Policy Branch began an extensive year-long study into the communications needs of the province. The post-secondary educational institutions began several local initiatives in provision of delivery services for distance education. The most notable of these was the response of the University of Saskatchewan to the satellite experiments sponsored by the Federal Department of Communications which culminated in Uplink '81 and Uplink '84 in which a number of post-secondary institutions participated to deliver educational programming by satellite (Brown,1989, p.454). The University of Regina began experiments delivering credit courses to remote sites using the fibre optics network. Experiments using slow scan television, teleconferencing, computer conferencing, and broadcast television were attempted. No major province-wide sustained initiatives resulted until the formation of the Saskatchewan Tele-Learning Association Inc. (STELLA) in late 1986 (Brown, 1989, p.457).

At about the same time the Department of Advanced Education and Manpower began to draft policy directed toward Distance Education Projects which *improve accessibility to programs and services in post-secondary education for all citizens of Saskatchewan.* In an undated "draft" policy statement the Department indicated that funds might be forthcoming to support Distance Education Project initiatives which:

(1) research, integrate and apply theoretical and perceptual perspectives in practical situations;
(2) lead to organizational or institutional improvements that have potential for system-wide application;
(3) promote involvement of other government departments, agencies and the private sector;
(4) encourage interinstitutional cooperation in development and testing of new delivery methods; and,
(5) can be sustained financially over a long term and integrated into regular institutional operations.
(Sask. Advanced Education, p.1)

Fired by numerous reports, the possibility of funding, various experiments, and a great deal of technological optimism the citizens and educators of the province were highly enthusiastic about the announcement on April 13, 1984 by Saskatchewan Communications Minister Gary Lane that *residents will soon have the opportunity to respond to a government white paper proposing the creation of a Saskatchewan Communications Advanced Network* (Lane, 1984, p.2).

SCAN WHITE PAPER

The news release accompanying the SCAN proposal announced that the new network would carry a variety of new communications services to the public, including community television, cultural information, educational services and access to computer data bases. The news release went on to indicate that the Communications Policy Branch in collaboration with the Departments of Agriculture, Culture and Recreation, Advanced Education and Manpower, Education and Sask Tel had conducted a year-long study into the communication needs of the province. The Minister announced that the study had resulted in a white paper which would culminate in public hearings to be held throughout the province. He went on to assure the public that they would be given every opportunity to comment on SCAN's desirability. He said *since SCAN had the potential to further development of an information industry in Saskatchewan and provide the province's citizens with new learning opportunities, the public must be given every opportunity to express its views on the white paper.* (Lane, 1984, p.3)

The text of the white paper contained an open letter from Gary Lane the Minister responsible for Communications expressing his desire to involve the public in the decision to create an advanced network. The content of that letter is reproduced here because it establishes the climate that prevailed at the time and was eventually instrumental in what can only be described as a phenomenal response to the proposal.

Dear Sir or Madam:

It is my pleasure to invite you to become actively involved in the formative stages of an exciting proposal filled with tremendous potential to satisfy the many educational and cultural communications needs of Saskatchewan residents.

Today's accelerated evolution of communications technology, working with novel applications of traditional technologies, is transforming our society. The coming years will offer many new possibilities which in the past have lived only in the imaginations of visionaries and futurists.

Our province currently possesses one of the world's finest telecommunications systems - the SaskTel network. Yet this very network, if used with foresight and imagination, could become increasingly responsive to escalating future demands. The potential exists for creation of an advanced telecommunications network which would greatly enhance the exchange of information throughout the province in areas such as education, agriculture, technical training, skills upgrading, culture and the arts.

The question to which I invite your response is whether we want to create such a communications advanced network within our province. As the new network could impact greatly on methods available to those wishing to transmit and exchange educational and cultural information, you have a right to comment on its desirability. I ask that you consider the attached proposal carefully and then offer your impressions of the issues, either a written brief or an oral presentation, at one of the scheduled hearings.

On behalf of the Government of Saskatchewan, I encourage you to participate in the consideration of the Saskatchewan Communications Advanced Network (SCAN) and look forward to receiving your comments and ideas at the public hearings.

signed *Gary Lane, Minister Responsible for Communications*
(Lane, 1984, p.ii)

The objective of the white paper was to describe SCAN and its potential to the public and to solicit public reaction to the SCAN proposal. A brief historical overview described development leading up to the proposal. The paper went on to describe the physical and organizational composition of SCAN, set out its limitations and explain how views were to be made known. The paper pointed out that SCAN would initially be carried on the provincial telephone system and SaskTel's fibre optic cable network or Broadband Network (BBN). The telephone network would reach all the province's communities with some form of information communications. As the BBN would reach fifty-two communities by the end of 1984, approximately sixty percent of the province's population could have access to the full services of SCAN. SCAN services would be delivered by:
(1) specialized television: educational, informational and cultural programming would be available to anyone on the cable television network:
(2) telephone conferencing: interaction between groups would be a possibility wherever the telephone system reaches;
(3) information data banks: could be accessed from anywhere on the telephone system through use of specialized equipment.

It would be possible for these technologies to be used individually, or in conjunction with one another. A live *televised presentation originating in one community could, for example, be carried either to all or to select communities on the BBN, while the viewing audience might be linked via telephone conferencing to facilitate questions and discussion. In certain communities served by the network, specialized SCAN centres could be established for the purpose of providing easier access to otherwise unavailable services. All the equipment necessary to conduct meetings, including data access terminals, telephone conferenceing equipment and television receivers, could be supplied at such centres.* (Lane, 1984, p.3)

It was proposed that administration of the network be provided by an "arm's length" public agency responsible to the Crown. This type arrangement would allow SCAN to be responsible to the public and be fully objective in its dealings with users. The SCAN agency would seek access to the designated educational channels on cable television and negotiate a "rate" with SaskTel for use of the telecommunications network. The primary function of the agency would be "administration of the network". Groups, non-profit organizations, government departments, universities and community colleges could apply to the agency for "access to the network facilities". To ensure optimal utilization it was proposed that the agency would be responsible for effective scheduling of unused network time to provide programming continuity and to service groups with special information needs.

The white paper foresaw the following individuals benefiting from the SCAN services:

**members of Saskatchewan's arts and cultural organizations, who could employ SCAN services to exchange information and provide a common cultural experience to an expanded audience;*
**volunteer organizations;*
**senior citizens, who could view television programs advising them of special health care services;*
**farmers and ranchers;*
**professionals who could hold meetings linked via telephone conference with colleagues in other SCAN centres;*
**those wishing to upgrade their skills without traveling long distances to seminars;*
**kindergarten to grade 12 students, who could receive network television programming during school days; and,*
**students, who could take sections of, or entire credit courses, without having to leave homes or jobs to relocate in distant cities, as instruction could be received at home (or at a local SCAN centre) through network services, i.e television, telephone conferencing or videotex.* (Lane, 1984, p.5)

The proposal cited several other benefits of SCAN:

the long term saving in time and money which could be realized through enhanced information transmission.

The traditional practice of constructing schools and supplying teachers to train people is expensive, and the use of space and time is not necessarily efficient. However, it has been estimated that sixty percent of certain trades courses could be taught outside the traditional school by using techniques such as television, videotex and telephone conferencing or some combination of these technologies. SCAN, therefore, could be of considerable benefit to those students wishing to take advantage of the Saskatchewan Government's initiative to increase training opportunities for technical-skilled workers.

The often prohibitive cost of traveling to a larger centre for further education would be reduced, as a network could improve access to educational opportunities by expanding the choice of courses available in smaller communities.

The realm of arts and culture also would benefit from SCAN, as Saskatchewan's artists, writers, performers and producers discovered new markets for their work through expanded opportunities.

The potential also exists for SCAN to be the catalyst for the development of an information industry. The network, as a market for high quality educational materials, could encourage the systematic gathering, packaging and distribution of Saskatchewan's recognized expertise in agriculture, mining, administration and the arts. (Lane, 1984, p.5-6)

Saskatchewan residents were invited to share their views of the proposed network before a hearing committee by submitting a written brief, delivering an oral presentation, or submitting a written brief summarized in an oral presentation at a hearing. The hearings were to take place from October 15 to November 16, 1984. Mr. Wayne D. Kyle was appointed by the Minister to chair a five person hearing committee and to conduct hearings in ten locations across the province: Regina, Estevan, Yorkton, Tisdale, Humboldt, Swift Current, Prince Albert, LaRonge, North Battleford and Saskatoon. Public response to the proposal was expressed in 121 submissions in seven broad areas: education, culture and heritage, health, agriculture, production and communication, libraries and associations. Support for the proposal was voiced in 83% of the presentations.

Based upon the content of the presentations, public comment, and lengthy discussion the hearing committee concluded that:

1. The Government of Saskatchewan should establish the Saskatchewan Communications Advanced Network (SCAN) and proceed in the following manner:
1.1. Design a system and, with appropriate consultation, obtain feedback on the design and make suitable revisions prior to implementation. The design should include descriptions of and cost estimates for a headquarters, pilot SCAN centres, appropriate interfaces with existing organizations, management structures, production facilities, budget requirements, program cost estimates and other identifiable operational requirements. The design also should:
1.1.1 outline proposals for the extension of the full range of SCAN services to the entire province.
1.1.2 identify operating educational communications systems elsewhere which should be examined with a view to determining how best to proceed with implementation in Saskatchewan.
1.1.3 identify operating prototypes within the province which should be considered in the design and which may be used to illustrate typical SCAN services to the public.
1.1.4 include an investigation of the feasibility of appropriate methods of attracting production capital from various sectors.
1.1.5 utilize and permit development of all modes of communications technology and ensure consistency and compatibility of technology wherever possible.
1.2 Stimulate the production of Saskatchewan oriented materials for data banks, educational/cultural television and teleconferencing through the provision of seed money.
1.3 Commence liaison with all agencies involved with the provision of educational, cultural and communication services.

2. Consideration should be given to a statement of purpose for the system such as the following:
To encourage, facilitate and coordinate the use of communications technology in Saskatchewan in order to enhance the development and delivery of educational, informational and cultural programs for the improvement of human and economic resources.
3. The Saskatchewan Communications Advance Network should be created by an act of the Saskatchewan Legislature and be responsible to the Legislature through a Minister of the Crown:
3.1 It must have autonomy but should be held accountable to the Minister.
3.2 A board of directors created under the authority of the Act should have representation from educational, cultural, industrial, labour, Indian, Native, and agricultural communities. It should also have some members appointed at large with the total membership not to exceed fifteen.
3.3 Regional advisory boards with regional representation should be established. These would provide input to the central board and exercise influence over regional matters.
4. Public access to the network should be safeguarded with regulations ensuring input to policy making, scheduling, production, use of media tools and planning. Ongoing response and feedback are imperative.
5. Provincial funding, particularly at the implementation stage, is necessary. The system may have the potential to become financially self-suficient.
6. The specific functions of SCAN should include:
6.1 Providing a gateway to electronic "highways" in the province for informational, educational and cultural purposes.
6.2 Co-ordinating and facilitating roles among users and providers of information and communications services in Saskatchewan where electronic technology would be useful for informational, educational and cultural purposes.
6.3 Creating the atmosphere and opportunities for institutions, organizations and individuals to utilize the network better, faster and more efficient services.
6.4 Fostering the development of distance education in Saskatchewan.
6.5 Promoting and sponsoring training programs for users and providers of services.
6.6 Conducting ongoing evaluation of SCAN services.
6.7 Ensuring standards for technical quality and transmission of programs.
7. SCAN must develop a harmonious and productive relationship with many institutions and organizations in the province. These include the library system, education system, health system, government departments, crown corporations and many other associations and organizations. Utilization of existing systems and resources, as much as possible, should be a fundamental operating principle.
8 . SCAN centres should be established throughout the province. The board and regional advisory boards should identify locations for these.
9. SCAN should become a catalyst and clearing house for research and development in the communications and information industry. (Kyle, 1985, p17-19)

SASKATCHEWAN COMMUNICATIONS ADVANCED NETWORK

The report of the SCAN Public Hearing Committee was transmitted to the Honorable Gary Lane, Minister Responsible for Communications, on March 5, 1985. The report languished in the Communications Policy Branch until January 11,1989 when an Order in Council proclaimed the formation of a Board of Directors to co-ordinate the creation and implementation of the Saskatchewan Communications Advanced Network as a Crown Corporation. Thus after a gestation period of almost five years SCAN is closer to reality, although the legislation has yet to pass the House. Announced formally at the end of May in conjunction with the Global Agricultural Technology Exposition (GATE), SCAN has made impressive progress during the last six months.

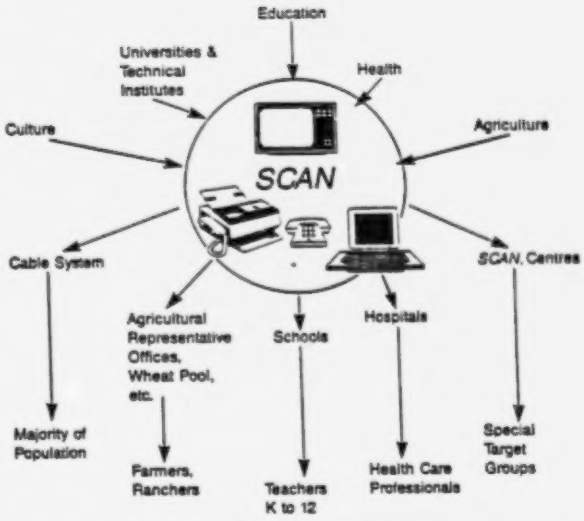


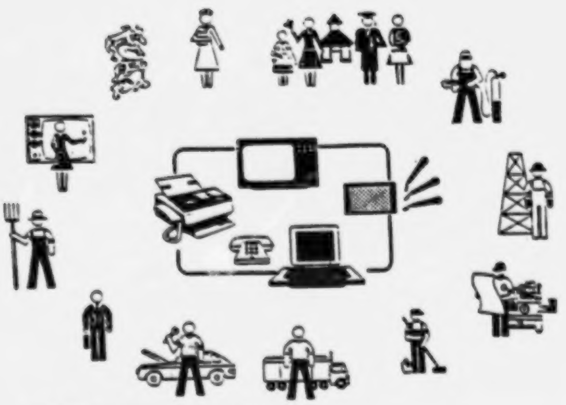
Figure 2 SCAN
EQUAL ACCESS TO INFORMATION FOR ALL RESIDENTS OF SASKATCHEWAN

Faced with the carefully considered guidelines cited in the Kyle report and the findings of the earlier reports which triggered the white paper the SCAN organization is making good progress checking off a number of the specific recommendations. SCAN has established as its specific mandate *to provide equal access to information to all Saskatchewan residents.* (Hersche, 1989, p.1). In a news release announcing SCAN the Minister confirmed the intention to serve all the residents of Saskatchewan.

There currently exists within the province a billion dollar telecommunications network. We are establishing a network not only for television delivery, but also for telephone conferencing and computer networking. The SCAN proposal is to establish one highly sophisticated shared-use system to be used by the government, non-profit and business sectors for delivery of programming to widely dispersed audiences. The network will expand educational opportunities throughout the province, and provide rural residents with the same access to information as is currently available to people in the urban settings (Lane, 1989, p.2).

NARROWCAST NETWORK

In order to achieve this aim SCAN has undertaken construction of three inter-related networks -Narrowcast Network, Public Broadcast Network and Data Network. The Narrowcast Network is presently providing programming. SCAN and the Saskatchewan Tele-Learning Association (STELLA) amalgamated July 1, 1989 with SCAN assuming responsibility for operation of the existing STELLA satellite



EQUIPPED WITH
•LARGE TELEVISION SCREEN
•COMPUTER TERMINALS
•TELEPHONE CONFERENCE EQUIPMENT
•FAX MACHINE
•AUDIOVISUAL EQUIPMENT
•CLASSROOM EQUIPMENT

Figure 3
SCAN CENTRE 35 "ELECTRONIC CLASSROOM" RECEIVING SITES THROUGHOUT SASKATCHEWAN

distribution system and the 33 former STELLA Centres. STELLA has assumed a revised role which includes stimulation, development, and coordination of distance education in Saskatchewan (Rudichuk, 1989, p.1). In the spring of 1989 STELLA was *assessed by the Director of International Business for Ford Aerospace as one of the top 10 concepts in the world.*(Hersche, 1989, p.2).(An overview of STELLA can be found in Brown, 1989, p.459-462) SCAN is committed to maintaining the forefront in delivery of distance education to the residents of the province. Specifically the Corporation has:

•negotiated a series of contracts with Regional Colleges to maintain and to operate these centres on its behalf;
•provided a consistent and reliable equipment maintenance and operational base for SCAN Centres. Participants in all centres have access to live, interactive televised programs (one-way video, two-audio), audio-teleconferencing, and facsimile machines to facilitate and enhance communication with resource personnel;
•developed a centralized 24 hour, help line for technological problems in SCAN Centres throughout the province and to provide contacts for needed local maintenance for SCAN's equipment (Hersche, 1989, p.3).

In 1990 the SCAN Centres will be increased from 35 to 56 to increase cost effectiveness for rural students, and will increase to 100 over the next five years. Plans also call for provision of more than one simultaneous satellite signal to permit marketing the Narrowcast service to the business sector. A scrambler/descrambler is contemplated for each Centre to assure a secure signal to commercial clients and health care agencies. Funding negotiations with the Federal Government include purchase of 400 satellite dishes to provide rural schools not on the cable system with the opportunity to receive SCAN programming. A Saskatchewan company has initiated production of commercial quality dishes to service this need. Another Saskatchewan company was awarded the contract to service up-link equipment.

PUBLIC BROADCAST NETWORK

A programming and technological infrastructure is under development for the SCAN Public Broadcast Network (PBN). The PBN will provide for a range of educational and informational programming over the existing cable television system. Over 178,000 provincial households will receive a range of alternate programming directed specifically to the needs of Saskatchewan residents. The network was originally to begin programming January 1, 1990, but this date has now been revised forward. In establishing the PBN, SCAN has:

•constructed a two channel satellite uplinking station at the University of Saskatchewan;
•entered into a contract with the University of Saskatchewan to provide tape playback and distribution services for SCAN;
•developed a fibre optics and microwave network which will allow for originating signals from Moose Jaw, Regina, Saskatoon and Prince Albert;
•offered a grant of $2,000 to each of the small rural cable television licensees to assist the purchase of a satellite dish to receive and distribute the SCAN signal (Hersche,1989,p.2).

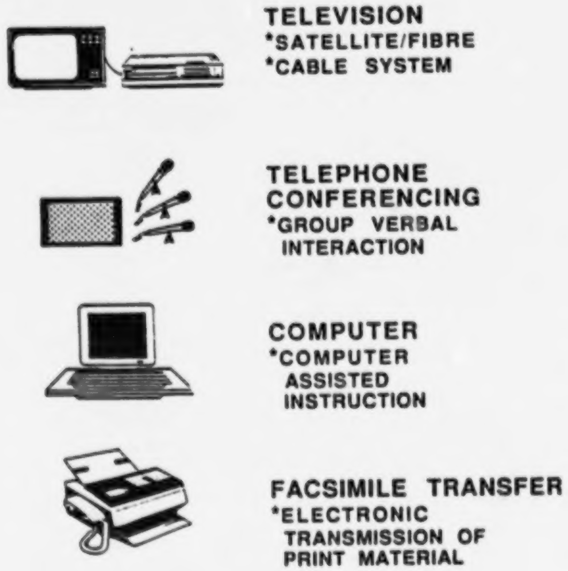
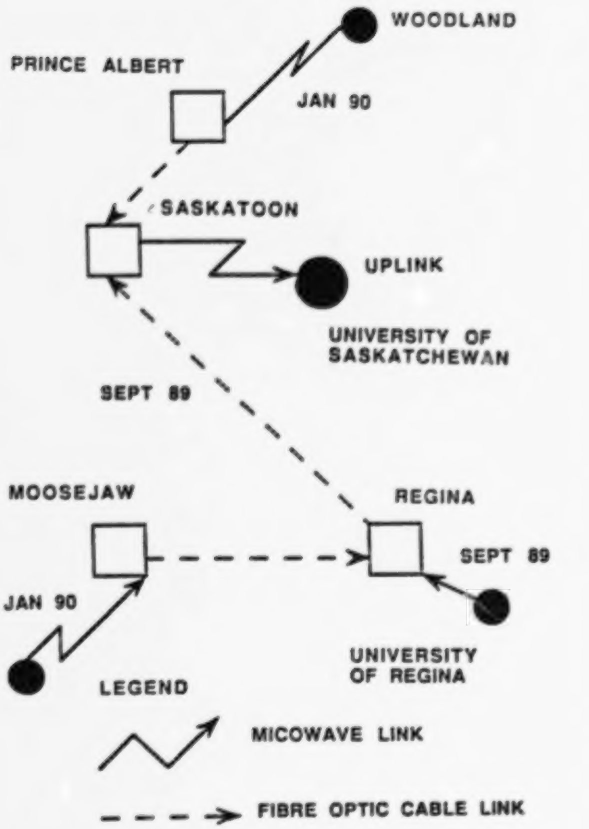

TELEVISION
•SATELLITE/FIBRE
•CABLE SYSTEM
TELEPHONE CONFERENCING
•GROUP VERBAL INTERACTION
COMPUTER
•COMPUTER ASSISTED INSTRUCTION
FACSIMILE TRANSFER
•ELECTRONIC TRANSMISSION OF PRINT MATERIAL

Figure 4
SCAN COMMUNICATION SERVICES

Funding for implementation of SCAN is in part the result of a Federal/Provincial funding agreement to encourage Saskatchewan's innovative approach in the development and application of advanced communications technologies and services. The total agreement with the Federal Government is $17-$18 million over five years (Lane, 1989, p.2). The provincial Government has committed funds to bring SCAN expenditures above the $5 million level per year for the next five years. PBN will air programming in four major theme areas: *Health, Lifestyles and the Family, Agriculture and Rural Development, Education and Lifelong Learning and Economic and Cultural Development* (Ewert, 1989, p.1). A Program Manager is responsible for each of the four areas. SCAN expects programming funds will be assigned:



IN 1989-90 75% OF SCAN PROGRAMMING WILL ORIGINATE IN AND BE UPLINKED FROM THE UNIVERSITY OF SASKATCHEWAN

20% OF PROGRAMMING WILL ORIGINATE IN REGINA AND WILL BE BACKHAULED TO THE UNIVERSITY OF SASKATCHEAN

PRINCE ALBERT AND MOOSE JAW WILL SHARE THE REMAINING 5% OF PROGRAMMING

Figure 5
PROPOSED SCAN BACKHAUL NETWORK JANUARY, 1990

In principle, SCAN will direct 50% of all available program funding to acquisitions with the remaining 50% being directed to Saskatchewan productions. The approximately 50% of available programming funds invested in Saskatchewan production will result in approximately 15% of the total programming time. It will, however, result in considerable support for the budding film industry in the province and generate direct economic spin-offs within the Saskatchewan economy. Already many Saskatchewan producers are considering capital investment to take advantage of the opportunity SCAN presents.

The major thrust of SCAN programming will continue to be in the education sector. A minimum of $2.0 M for acquisitions and productions will be directed to distance education programming on both the Narrowcast and Public Information systems. SCAN will work closely with various government departments and non-profit groups to ensure that the programming on the respective networks reflects the requirements of Saskatchewan residents.
(Hersche, 1989, p.3)

DATA NETWORK

SCAN has committed itself to a multi-mode delivery strategy. The Minister stated *by making a variety of communications services available, SCAN will enable user agencies to deliver programming in the most suitable and cost-effective way* (Lane, 1989, p.7). Consumer data, access to library resources, agricultural information and current health information was cited as being facilitated through increased access by the general public to computer data bases. SCAN is initially planning one computer for each Centre. Emphasis will be placed on development of software which will allow residents with limited knowledge of computer technology to access data. SCAN foresees the DATA Network now under development will:

•*provide an alternate medium for the delivery of distance education programs as opposed to the total reliance upon the more expensive video/satellite based system. As an example rural communities in Southern Saskatchewan will be able to receive competency based learning programs produced by Woodlands Campus in Prince Albert. Currently only selected northern communities receive this programming.*
•*provide public access to various public and departmental data bases. There are a number of data bases such as the Western Procurement system and the Western Information Network to which the Economic Development departments of the province would like to provide public access. As small business becomes familiar with the economic advantages of these systems, it is anticipated that they will begin to develop their own access points.*
•*to enhance communications within the Narrowcast Network through the use of electronic mail for co-ordinators, the distribution of scheduling information, and electronic bulletin boards. This will increase the effectiveness of the narrowcast system throughout the province as well as reduce long term operational costs stemming from over utilization of the phone system.* (Hersche, 1989, p.5)

CONCLUSION

SCAN has been received enthusiastically by the residents of Saskatchewan. The people of the province generally accept that a need exists for increased access to information if they are to compete effectively with the rest of the world. The reality of a sparse population and vast distances punctuated the need for effective communications 75 years ago when the province embarked upon development of a sophisticated telephone system for the time - this telephone network has been maintained as world class and the residents have maintained their desire for linkage. All echelons of endeavor in the province wish to enter the 1990's party to a communications network capable of connecting them to each other and to the world. This has been evident since the early 80's. Review of the development of the Saskatchewan Communications Advanced Network reveals that the leading thinkers of the time had a very clear concept of the need for and the configuration of the information system suitable to accommodate the special characteristics of the Saskatchewan people in regard to their education, industry, business, health and culture. Contemplating the score card it appears that to this point SCAN has responded to six out of ten recommendations underlying its creation. This is by no means a bad score considering SCAN is only in its sixth month of operation, and neither the Legislation nor the representative board of directors is firmly in place. It is unfair to be excessively judgmental at his juncture.

In spite of the long period between the recommendations of the white paper and the inauguration of SCAN, distance education continued to develop in the province. Due to the pioneering efforts of the Saskatchewan Tele-Learning Association in development of an interactive full-motion satellite television delivery system SCAN has been able to immediately begin delivering credit and non-credit programming. Programming of the University of Saskatchewan's credit courses by satellite and the University of Regina's credit courses by fibre optics have continued under SCAN. Development of additional uplinks, extension of the SCAN Centres, development of the Narrowcast Network and addition of computer services appear to have enhanced the award winning STELLA concept. Effective September 1989 SCAN began to absorb satellite and other related fees for non-profit organizations. Program costs remain the responsibility of the program organizations. Program producers will contract directly with Saskatchewan's film and video industry. SCAN has initiated a policy of "seed" or "motivational" funds to conduct initial planning or feasibility initiatives. These grants are in the order of $5,000 depending on the circumstances of the prospective production.

SCAN has already had a direct impact on business and industry, with one company initiating manufacture of commercial quality satellite dishes and other companies experimenting with satellite uplinking systems. Technical support of the Narrowcast Network is being carried out by local Saskatchewan companies. The Saskatchewan Motion Picture Industry Association (SMPIA) has been closely associated with early development work initiated by SCAN. Many SMPIA members have initiated productions for the network and others are tooling-up to take advantage of the production vacuum created for Saskatchewan based programming.

The eyes of Saskatchewan and of many others who are external to provincial boundaries will be focused on SCAN over the next few months. The front-end work has been done well, cautiously and deliberately, as is characteristic of Saskatchewan people. Now it remains to be seen how quickly and efficiently the small core of dedicated individuals who make up the initial complement of SCAN management can bring the information services on stream. This will be no small task in light of the consideration that must be accorded the politics of the situation, the funding, the economy and the diverse expectations held for SCAN. The outcome will be watched with great interest!

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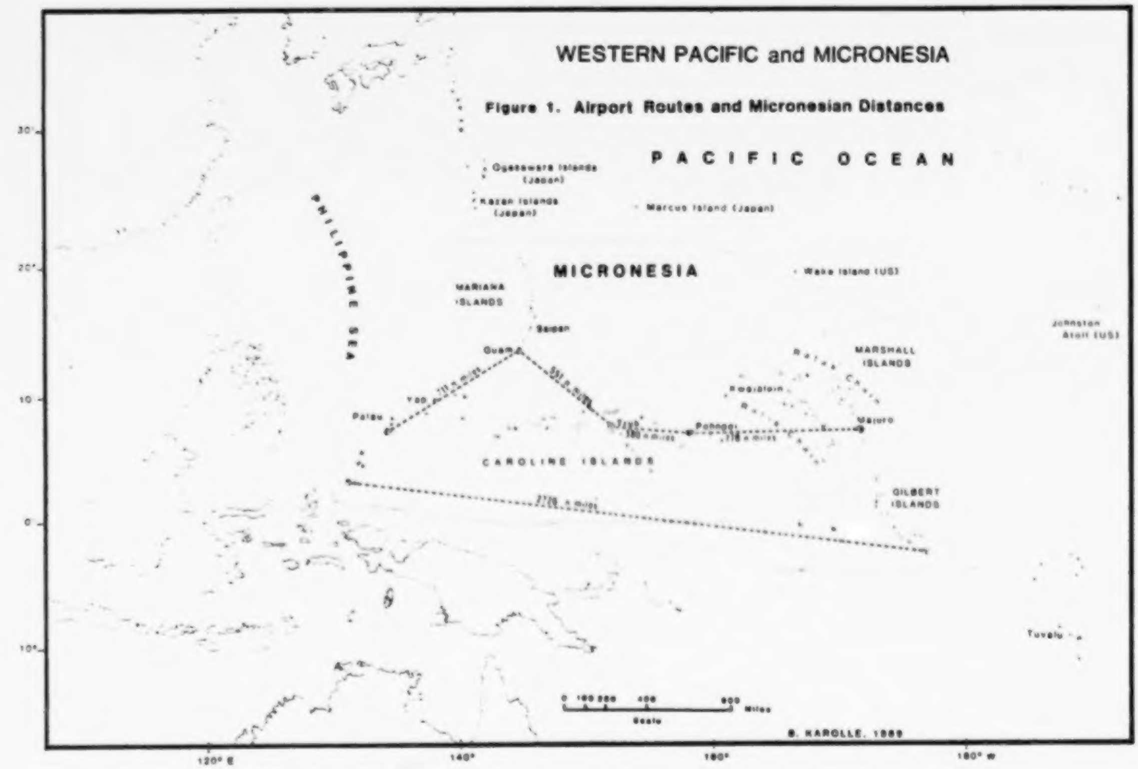
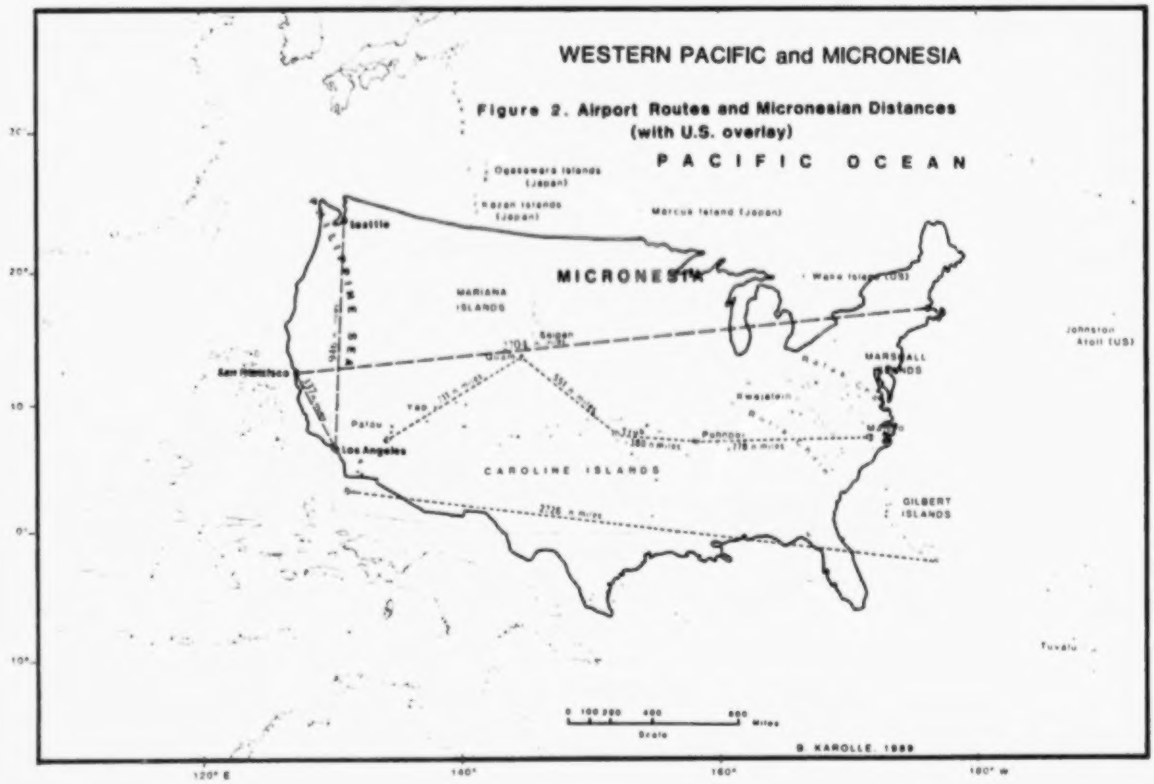


WESTERN PACIFIC and MICRONESIA

Figure 1. Airport Routes and Micronesian Distances

PACIFIC OCEAN
Ogasawara Islands (Japan)
Kazan Islands (Japan)
Marcus Island (Japan)
PHILIPPINE SEA
MICRONESIA
Wake Island (US)
MARIANA ISLANDS
Saipan
Guam
Johnston Atoll (US)
MARSHALL ISLANDS
Ralik Chain
Ratak Chain
Kwajalein
Yap
Palau
Truk
Pohnpei
Majuro
CAROLINE ISLANDS
GILBERT ISLANDS
Tuvalu
Miles
Scale
B. KAROLLE, 1989
30°
20°
10°
0°
10°
120° E
140°
160°
180° W



WESTERN PACIFIC and MICRONESIA

Figure 2. Airport Routes and Micronesian Distances (with U.S. overlay)

PACIFIC OCEAN
Ogasawara Islands (Japan)
Kazan Islands (Japan)
Marcus Island (Japan)
Seattle
MICRONESIA
Wake Island (US)
MARIANA ISLANDS
Saipan
Guam
San Francisco
Los Angeles
Johnston Atoll (US)
MARSHALL ISLANDS
Kwajalein
Yap
Palau
Truk
Pohnpei
Majuro
CAROLINE ISLANDS
GILBERT ISLANDS
Tuvalu
Miles
Scale
B. KAROLLE, 1989
30°
20°
10°
0°
10°
120° E
140°
160°
180° W

Developing and Delivering Cost Effective Distance Education In Micronesia: The University of Guam's Experience in Bridging the Low and High Tech Gap.

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Mangilao, Guam, USA

ABSTRACT

The University of Guam has actively been experimenting with distance education techniques since the early 1980's. This paper is the University's first major attempt to summarize its experiences in delivering distance education within American Micronesia. To facilitate this attempt, this paper is divided into six sections. These sections are: (1) the geographic setting — what distance education really means in Micronesia; (2) distance education at the University of Guam; (3) the technical base; (4) delivering post secondary education in Micronesia; (5) an experimental distance education model; and (6) prospects for the future.

1. The Geographic Setting — What Distance Education Really Means in Micronesia?

The designation "Micronesia," as used throughout this paper, refers to a geographic area encompassing an enormous expanse of the tropical western Pacific Ocean. Defined and delimited as an areal unit, or a portion of the earth's surface, it comprises a recognized region of the world and has been in use on maps for over 150 years.

As the two maps indicate (Figures 1 and 2), land makes up a fraction (1,045.3 square miles or 2,707.2 km^2) of this oceanic region whose area is well in excess of three million square miles (>7 million km^2). Micronesia, as shown as an area within the 11-sided polygon (outlined on the maps by the dots...) , is one of the three major ethno-geographical regions of the Pacific World: the other two being Polynesia and Melanesia.

There are several island groups and newly established island states within the region: the Federated States of Micronesia, the Republic of the Marshall Islands, the Republic of Belau, the Commonwealth of the Northern Mariana Islands [all of which constituted the former Trust Territory of the Pacific Islands (TTPI)], Guam, Nauru, and the Gilbert Islands, including Banaba (formerly Ocean Island) in the Republic of Kiribati.

"American" Micronesia designates the major portion of the region. Guam and the islands of the former Trust Territory, the new island states listed above, account for approximately 89 percent of the total land area of Micronesia. The University of Guam actively pursues programs serving the peoples living within American Micronesia.

Micronesian geographic distances are indicated in Figure 1. The extremes of latitude cover approximately 23 degrees. The northernmost land point in Micronesia is on the island of Farallon de Pajaros in the Mariana Islands at 20.33 degrees north latitude; the southernmost point is in the Gilbert Islands, Kiribati, on Arorae at 2.39 degrees south latitude. The maximum north to south distance is thus 1,387.2 nautical miles or 1,595.28 statute miles.

The east-west distances are even greater, covering over 45 degrees of longitude. The distance between the small island of Tobi, in Palau, within a few hundred miles of Indonesia and the Philippines, at 131.10 degrees east longitude, and the easternmost atoll af Arorae, Kiribati, at 176.54 degrees east longitude, is approximately 2,726 nautical miles (3,135 statute miles), or about the same as the distance across the United States from coast to coast.

Figure 2 shows the comparative distances between American Micronesia and the continental U.S., indicating how distance education relates to basic geographical ideas. This comparative method of viewing distance similarities between American Micronesia and the continental U.S. is a case in point. The comparative sizes are viewed by superimposing the map of the U.S. over the base map of Micronesia. As can be seen in Figure 2, the land size of the conterminous 48 United States and the new states of American Micronesia (Guam and the former Trust Territory of the Pacific Islands) is approximately the same.

The great distances separating the various islands and political entities within Micronesia play a determining role in transportation difficulties in the region. As an example, the airport-to-airport distances — in the Federated States of Micronesia — between the state capitals, or district centers as they used to be called, are listed below:

Island-to-Island	Nautical miles
Pohnpei - Kosrae	320
Truk (Moen) - Pohnpei	380
Yap - Pohnpei	1,200

These data also illustrate the problem of geographic fragmentation throughout the region. This may be seen in the following list of distances from Guam, which is the communication, transportation, and educational (campus location of the University of Guam) hub of American Micronesia:

Island-to-Island	Nautical miles (airport-to-airport, total accrued distance)
Guam - Truk	551
Guam - Yap	466
Guam - Palau	711
Guam - Truk - Pohnpei - Majuro	1,709

The long distances involved and the inaccessibility of many of the islands within American Micronesia have severely handicapped the University of Guam's attempts to provide effective post secondary education to the region. In the early 1970's the University depended on traditional delivery systems utilized primarily during the summer months when faculty from the main campus were available to travel off island.

The rise in transportation and living costs within American Micronesia, coupled with demands by the University's Micronesian clients for a cost effective year round post secondary system, during the late 1970's and early 1980's, have increasingly called into question the utility and cost effectiveness of traditional delivery systems. It is now becoming evident that, if the University is to continue to deliver direct educational services to Micronesia, it must develop alternative delivery systems to those it has used in the past. Distance education techniques and delivery systems may prove to be one of these alternatives.

2. Distance Education at the University of Guam

The University of Guam is the only four-year post secondary educational institution is American Micronesia. It offers a wide range of Baccalaureate programs and Master's degrees in the areas of art, biology, business, education and public administration.

The student body is relatively diverse. It consists of students from Guam, American Micronesia, the U.S. Mainland, the Philippines, and Asia. The present enrollment is approximately 2,400 students at the main campus. In addition, the University offers a variety of courses throughout American Micronesia described in Section 4. The University is accredited by the Western Association of Schools and Colleges.

As the only Baccalaureate granting institution in American Micronesia, the University has always recognized that it has a responsibility to serve the region as a whole rather than just the Territory of Guam. This recognition, combined with the geographic and cost factors described above, led the University in 1985 to begin experimenting with distance education delivery systems and technology to supplement its traditional delivery systems.

The first experiment was conducted in Kosrae State of the Federated States of Micronesia, utilizing the PEACESAT Networks ATS 1 Satellite. Prior to 1985 the University participated in the PEACESAT project and served as the hub for Micronet which connected the main islands of American Micronesia. Micronet was used for a variety of purposes, the most important of which were teleconferencing, medical communications, and emergency communications.
This project was a joint undertaking between the Kosrae Department of Education and the Colleges of Education and Arts and Sciences of University of Guam. The relative success of the experiment led the participants to begin planning a second course via satellite for Kosrae.

Unfortunately, NASA's ATS-1 satellite was shut down in late 1985 and the PEACESAT network in Micronesia ceased to operate. This occurrence forced the University to place further distance education experimentation on hold for the next two years.

In the fall of 1987 this situation began to change when the University agreed to purchase and equip a single sideband radio system capable of transmitting to all jurisdictions within American Micronesia. Licenses were obtained from the FCC and the University began broadcasting in January, 1988.

The University's commitment was further strengthened in December, 1987, when the president of the University, Dr. Wilfred P. Leon Guerrero, established the Telecommunications and Distance Education Operation. The Operation was placed under the administrative control of the director of the Center for continuing education and outreach programs. During the next six months a coordinator for the Center, Dr. B. Camacho-Dungca, was selected; a part-time technician was employed; a temporary radio room was established; and the University's radio equipment was upgraded.

While the University was setting up its Telecommunications and Distance Education Operation, PEACESAT members, including the University of Guam, were lobbying with the U.S. congress to reestablish their network. In 1987 these efforts met with success. In that year Senator Inovye of Hawaii sponsored legislation which appropriated approximately US$3.6 million as part of the budget of the National Telecommunications and Information Administration (NTIA) to reestablish PEACESAT.

During 1988, NASA's ATS-1 satellite was made temporarily available for PEACESAT. NTIA and the PEACESAT users have spent the last year seeking a more permanent replacement which will be in operation sometime during 1990. The University of Guam's Telecommunications and Distance Education Operation presently maintains an ATS-1 terminal and will be an active participant in future PEACESAT activities.

The development of the University of Guam's Telecomunications and Distance Education Operation and the potential offered by a renewed and expanded PEACESAT network, once again led the University to begin experimenting with distance education techniques. Two courses were offered via single side band radio to Pohnpei and Kosrae. The experience gained from these courses and the course offered in 1985 laid the basis for the development of the model described in section 5. of this paper.

3. The Technical Base

In a little over ten years, educational and medical telecommunication in American Micronesia has transcended from meteor scatter and HF-SSB phone patch systems to Intelsat service and remote solar-powered computer-integrated up and down links, specifically utilizing the ATS-1 PEACESAT system and the planned G.O.E.S. geosynchronous repeater. Tropical Oceania is, at present, the least cost effective area in the world for commercial carriers. With the exception of the Marianas archipelago, fiber, cable and microwave techniques are basically uneconomical in the Pacific Basin. In delivering educational and primary care information to the region the telecom provider must utilize SSB-HF or a low-cost high-powered satellite link and marinized, innovative and technically simple — field serviceable — ground equipment.

Today, many educators in the Pacific rely on costly travel and when available, commercial communication links to deliver their message. Through the PEACESAT network the Pacific has been experimenting with low cost remote satellite links since the late 70's. For many years, medical and general educational traffic was passed through the high powered VHF ATS-1 satellite which provided reliable international communication links for the smaller islands in Oceania. The ATS-1 satellite has been reactivated for PEACESAT use until late '89 on an interim basis. The Department of Commerce is mandated by law to replace the system. To demonstrate the utility of a world-class solar-powered satellite communication system that could interface with a micro-computer, the University designed and demonstrated a compact solar powered electronic mail-integrated VHF up an down link.

The original experimental electronic mail system utilized Apple II micros and Data Capture software interfaced with a modified Hayes Micromodem (baud rate of 300 and half duplex). In Micronesia this system was in use only at the University of Guam terminal. In early 1985 thanks to the progressive Rehab Research and Training group out of the University of Hawaii (RR&T), all Micronet stations were upgraded with a modified Access II software package and Apple IIc computers. The standard Apple modem was modified to detect the carrier detect handshake, thus allowing a simple switchable modem for duplex phone or simplex radio. A small word processing program was generated to create a document on the Access II program. The software is compatible with Appleworks integrated data base, word processing, and spreadsheet packages. RR&T provided funds for training and the system worked well until ATS-1 was shut off.

Because of its recent uncontrollable drift, the ATS-1 system is no longer a long term viable option for Distance Education in American Micronesia. To accommodate the need for educational and medical communications, the University was asked to design a Single Side Band High Frequency radio system that integrated the photovoltaic power supplies currently in use with the ATS-1 Micronet system. The RR&T group again funded training seminars throughout the Federated Stated of Micronesia, Republic of the Marshall Islands, the Commonwealth of the Northern Marianas Islands, and Belau. Packet technology can be used with both SSB and Simplex Satellite systems.

Presently the University acts as the Micronesian control station for both the Regional Micronet SSB (HF radio) and the International ATS-1 Satellite (PEACESAT) system. It is presently experimenting with transmitting digital pictures, fax and data with the radio systems and is conducting distance education projects throughout the region.

Technically, the upgraded central communication room provides standard international and regional audio and visual links over both duplex phone lines and international, regional and local area radio links. Facsimile, slow scan video, digital telex and data base access, and normal analog voice traffic links will soon be available via both phone and radio. Live satellite CNN news/video links will be monitored. Micronesian educational and radio links — both satellite and terrestrial — will be available on a daily basis. Local area VHF capabilities will be developed to link the working UOG Marine Lab boats to the laboratory, and to directly link Rota, Tinian and Saipan educators to the University. The station will integrate a photovoltaic-charged battery back-up system to provide emergency links during typhoons or power outages and to provide continual power for our Macintosh.

4.. Delivering Post Secondary Training in American Micronesia.

The University of Guam first began offering off-campus coursework to Guam and Micronesia in 1974 when the Off Campus Program Center was established and placed under the administrative responsibility of the office of the Academic Vice President. Since that time, the office has remained under the purview of the Academic Vice President, but was renamed in 1988 to the Center for Continuing Education and Outreach Programs (CCE-OP). CCE-OP is presently responsible for all off-campus activity and is charged with the responsibility of coordinating all off campus and non-traditional training activity in American Micronesia. In December 1988 the University of Guam established the Telecommunications and Distance Education Operation and placed this activity under the responsibility of the CCE-OP.

Prior to 1974, the University of Guam (UOG) conducted classes only in the Commonwealth of the Northern Mariana Islands (CNMI). In 1965, when the islands of the CNMI were under the jurisdiction of the Trust Territory of the Pacific Islands (TTPI), 36 students were enrolled in education courses leading to an Associate's degree in elementary education. By 1984, UOG had served 5,264 students in the CNMI (Fig. 3).

Fig. 3
STUDENTS IN THE COMMONWEALTH OF THE NORTHERN MARIANAS ISLAND (CNMI) SERVED BY UOG ON-SITE FROM 1965-1984

YEAR	NUMBER OF STUDENTS SERVED		
	Saipan	Rota	Tinian
1965	36	0	0
1966	73	0	0
1967	46	0	0
1968	108	0	0
1969	77	0	0
1974	250	0	0
1975	289	0	0
1976	382	0	0
1977	231	20	0
1978	60	0	0
1979	535	58	0
1980	372	58	10
1981	432	77	0
1982	645	31	7
1983	121	18	0
1984	123	0	0
Totals	**4,046**	**280**	**17**

Total Students Served in CNMI: 5,264
Based on enrollment data from CCE-OP

There was a 5 year gap in delivering courses to the CNMI between 1969 and 1974. It was during this period that Saipan, the largest island of the CNMI, began development plans for the establishment of the Northern Marianas College, a 2 year institution. By 1976, the Northern Marianas College (NMC) was established. From 1983 to the present, UOG has agreed with NMC to deliver only upper division courses to the CNMI

In 1981 UOG began delivering courses to Pohnpei and Ulithi in the Federated States of Micronesia (FSM). The following year, UOG had increased coursework to all the FSM states; this included Kosrae, Truk, Yap, as well as Pohnpei and Ulithi. In addition courses were delivered to the Republic of Belau and to Majuro in the Republic of the Marshalls. Figure 4 shows a breakdown of courses delivered to Micronesia from 1979 to 1988.

Fig. 4
UOG COURSES DELIVERED ON-SITE TO MICRONESIAN STATES 1980-1988

Region	1980	1981	1982	1983	1984	1985	1986	1987	1988	Total
CNMI	20	20	17	0	6	0	7	5	7	**82**
Truk	0	0	0	11	15	11	14	23	10	**84**
Pohnpei	0	1	2	1	0	1	5	3	7	**20**
Kosrae	0	0	7	8	7	5	6	5	4	**42**
Yap	0	0	0	4	6	5	6	5	5	**31**
Ulithi	0	1	0	0	3	0	0	0	2	**6**
Palau	0	0	2	1	1	3	10	8	0	**25**
Marshals	0	0	3	8	8	6	4	3	6	**38**
TOTAL	**20**	**22**	**31**	**33**	**46**	**31**	**52**	**52**	**41**	**328**

Based on the CCE-OP Annual Reports from 1980-1988

In July, 1979, the UOG College of Education began negotiations with the regional governments to establish the Individual Degree Plan (IDP). This negotiation process began when the Northern Marianas College (NCM) requested UOG to evaluate the credits and transfer credits of 47 non-degreed teachers who were working toward a B.A. degree in education. The two institutions agreed that an IDP would be developed for each off-island educator/student based upon the 1979 UOG catalog and that it would indicate all remaining courses to be completed. Teachers in Micronesia, at that time, were in classrooms with little more than an Associate of Arts degree or less. The IDP was designed to move teachers through a degree program through outreach courses and courses that would need to be taken on the UOG campus. The IDP became a contract between UOG and the inservice educator/student in each of the islands.

The IDP waived the UOG regulation governing continuous enrollment. This IDP was initiated due to the extreme difficulty that regional students had in being able to enroll continuously for the period of time necessary to secure the B.A. degree. By November, 1982, the UOG College of Education had adopted policies and procedures governing all IDP students. Coursework could be taken through the on-campus program offerings or through courses that were delivered to the regional site. It gave students continuity in their program and allowed inservice coordinators to plan the series of courses that would lead to program completion. In addition, it defined course equivalencies, on an individual basis, with other postsecondary institutions in the Pacific. By 1983, there were approximately 1,500 students from across Micronesia who were enrolled in the IDP program.

Over the years, it has become evident to UOG that courses taught on campus were far more expensive and created significant funding and coordination problems for the regional governments. It was far more cost effective to deliver courses of site. When courses were delivered through CCE-OP, a standard tuition cost for all off-campus courses took effect. When students arrived on campus, even though they were given resident tuition rates, the cost per credit was four and one half times higher. The on campus per student cost was substantially higher than the off campus cost, even though the regional departments of education paid the living costs of instructors who taught on site.

Figure 5 shows an example of the cost comparison of providing training to 20 students, from the island of Truk in the Federated States of Micronesia, who earn 6 credits of coursework both on campus and off campus. Six credits was used as the basis for this comparison since students are typically able to earn credits only during the summer term and a minimum of 6 can be earned over the summer semester. During the regular academic year, IDP students are functioning as teachers in classrooms on their home islands and are not able to attend classes in either setting. Note the increase in cost per student utilizing the two traditional delivery modes that UOG has implemented over the last few years.

Utilizing the ATS-1 Micronet systems, UOG delivered, in 1985, its first distance education course By 1988, two other regular credit courses were developed for delivery over the low tech system that is now in place in Kosrae and Pohnpei. Distance education courses were not attempted prior to 1985 because telephone communication lines were of low grade, of poor quality or, in some cases, non-existent. Correspondence courses did not lend themselves well to course delivery, due to the unpredictability of the mails. It is still not uncommon for mail to take up to 2 to 4 weeks to get from Guam to any of the FSM states. It was not until the introduction of the ATS-1 satellite system with SSB radio backup that the possibility of using these low tech systems was attempted.

Fig. 5

COST COMPARISONS FOR 20 IDP STUDENTS FROM TRUK, FSM FOR ON-CAMPUS AND OFF-CAMPUS UOG COURSEWORK

Bringing 20 Students From Truk to the UOG Campus		
Regular airfare Truk-Guam and return	$	402.00
UOG Registration/Packet Fee		10.00
Resident Tuition: $45 x 6 credits		270.00
Dorm Charge: 42 days x $5 per day		210.00
Textbooks and supplies for two 3 credit hour courses: $50 x 2		100.00
Meals: 3 meals a day x $5 per day x 42 days		630.00
Cost Per Student for On-Campus Enrollment	**$**	**1,622.00**
Total Cost To Regional Government For 20 Students	**$**	**32,440.00**
Sending 2 UOG Instructors to Truk to Teach 2 Courses		
Regular airfare for 2 instructors at $402 per trip	$	804.00
Salary for 2 instructors at $2,500 per 3 credit hour course		5,000.00
Perdiem & car rental for 2 instructors at $102 a day x 42 days		8,568.00
6 credits x $10 per credit, Off-Campus tuition rate x 20 students		1,200.00
Textbooks and supplies for 2 courses $50 a course x 20 students		2,000.00
Total Cost To Regional Government For 20 Students	**$**	**17,572.00**
Cost Per Student For Off-Campus Enrollment	**$**	**878.60**

Early experiments in distance education gave the CCE-OP another option for delivering training to the many islands that are separated by the vast Pacific Ocean. Figure 6 shows the costs that were incurred from the early experiments in Kosrae and Pohnpei. The per student cost using the distance education mode was substantially lower. It became evident that UOG could not ignore the use of telecommuications in providing training to the Micronesian area. It has become even more critical when one considers that each of the newly formed freely associated states in Micronesia is presently facing significant budget reductions as the compact agreement curtails various U.S. funding options to these states.

Fig. 6

COSTS INCURRED TO DELIVER 2 COURSES TO TRUK, FSM USING DISTANCE EDUCATION (ATS-1 & SSB) FORMAT

Regular airfare for 2 instructors x 2 trips at $402 per trip	$	1,608.00
Salary for 2 instructors for 2 courses		5,000.00
Perdiem & car rental for 2 instructors for 2 days x $102 a day		408.00
Technical fees: fax, video rentals, cassettes, software, postage and other: $75 fee per student x 20 students		1,500.00
Textbooks & supplies for 2 courses at $50 a course x 20 students		2,000.00
6 credits x $10 per credit x 20 students		1,200.00
Total Cost To Regional Government For 20 Students	**$**	**11,716.00**
Cost Per Student For Distance Ed Delivery Of Coursework	**$**	**597.40**

Although the cost per student is significantly less using the distance education model for delivery, certain aspects of this form of training need to be carefully evaluated. Distance education, utilizing the satellite or SSB radio option, has some clear advantages. Students enrolled in this type of coursework can bring to the classroom the culturally relevant problems that are encountered in practice and in the field. Instructors within these courses can immediately assist students in addressing concerns and generate problem solving activities that would be pertinent to the island. Instructors at UOG can access library resource information through various computer networks that are not readily available to the islands. Problems in agricultural, medical, or educational areas, for example, can be addressed immediately. In addition, students in distance education courses can continue employment on their home islands. This is a very important aspect to training, since these islands have very limited human resource pools. Distance education will allow these individuals to stay on their islands, thus avoiding family separation, increased living costs, employment disruption, and other concerns that characterize off-island training. From the academic point of view, students who train in a distance education format must develop an independent approach to course work. Students must take more responsibility in learning course content prior to interactive sessions with the instructor over low tech systems. When students are given video tapes, software, and text material to spend time with, the opportunity for more efficient learning increases.

Disadvantages to distance education formats must also be seriously considered. The primary concern is that certain courses do not adapt well to distance education formats. Another concern is that instructor-student contact is limited and confined to interactive radio sessions for immediate feedback. Finally, many traditional academicians are hard to convince that the distance education format can maintain the inherent integrity of the course content. Further exploration and research has made a difference in this last concern. However, many accreditation boards are still developing policy on courses that are delivered over technology systems.

At the present time, the University of Guam competes with other mainland institutions such as San Jose State University, The University of Portland, The University of Maryland, Central Texas College, and United States International University in providing opportunities for postsecondary training in American Micronesia. These institutions offer limited degree programs on site for select islands in the region. Very often, their longevity on the island spans a 3 to 5 year period. The University of Guam is the only institution in American Micronesia that has served this region of the world for the last 37 years. It has dealt with the multicultural diversity of its constituents, it has shaped and continues to revise policy on the management of the multilingual population it serves. It has endured budgetary constraints, changing political status of the islands, and the evaluative processes of accreditation boards. As the University looks to the 21st century, it is clear, that the University of Guam will continue to explore innovative methods to deliver training and network with available resources in the Western Pacific.

5. An Experimental Distance Education Model

Between 1985 and 1989 the University of Guam developed and tested a Distance Education model in American Micronesia. The model is based upon the use of commercially produced video tape series to replace classroom lectures.

To date, two series have been tested within the region: Alistair Cooke's America, Kosrae, 1985; and The Ascent of Man, Kosrae and Pohnpei, 1989. In both cases the video tapes were available on site for viewing by the students. While a regular viewing date was chosen on site facilitators had the flexibility to allow students to view tapes at other times as well.

Each of the above video series consist of 13 tapes which run for approximately 50 minutes per tape. In the 1985 course a seven week time frame was utilized. As a result of student comments, it was decided that this time frame was too short, and in the 1989 experiments the time frame was expanded to 13 weeks.

The video tapes were supported by print materials and a syllabus which were available on site prior to the start of the course. The print materials consisted of the transcripts of each video tape session and additional history texts which supplemented the subject matter covered in the tapes and the transcripts. The syllabus contained the weekly reading assignments and a list of key terms which were used to guide and focus the students' reading.

Once each week the students gathered for an interactive discussion session with the instructor. These sessions were held via PEACESAT in 1985 and via single side band radio in 1989. The sessions were monitored by the on-site facilitator who had been selected and trained prior to the start of the course. In the 1989 experiments the instructor began the interactive sessions with a brief lecture highlighting the main points covered in the tapes and readings, and students were encouraged to give extra credit oral reports. The interactive sessions were recorded on audio cassettes for archival and review purposes.

Weekly quizzes were given by the facilitator, after each interactive session. The quizzes consisted of identifications and were open book. After their completion, they were sent to Guam for grading via the U.S. mails. In addition, in the 1989 experiment, formal writing was required of each student enrolled in the course for three credits.

In 1985 grades were based on the quizzes, a final, which also consisted of identifications, and class participation. In 1989 grades were based on the quizzes, the formal writing, and the extra credit oral reports.

In both instances the instructor traveled to each site to begin the course. During this visit, he introduced the course, conducted the first interactive session, and met the students. In 1985 he also visited the site to complete the course and to give the final examination.

This model is presently being revised by the University. The revision will be completed during the Spring, 1990, academic semester. Present plans call for the offering of a revised The Ascent of Man course during late 1990. If the revision is successful, the model will be utilized with other tape series in history and other areas within the liberal arts during the 1991 calendar year.

6. Prospects For The Future

At the present time the University is committed to expanding its telecommunications and distance education operations and offerings. The Telecommunications and Distance Education Operation will be housed in a permanent structure and its equipment expanded as outlined in section 3.

The University will also continue to serve as the hub for Micronet via single side band radio and PEACESAT. Hopefully, PEACESAT will receive access to a G.O.E.S. satellite during the next calendar year to replace ATS-1. S band terminals and Earth stations will be established at the University and throughout American Micronesia. Access to the G.O.E.S. satellite should provide the region with "near commercial" voice, data, and perhaps slow scan channels which will greatly enhance the region's distance education capabilities.

These capabilities will be further enhanced as course offerings are increased and new delivery models are developed. The University is presently offering a multi site agriculture and home economics course entitled "Extension Program Development in the Pacific Basin." This course is being offered throughout American Micronesia, Hawaii, and American Samoa via single side band radio. It pairs sites in its interactive sessions and is utilizing innovative print materials to supplement the radio sessions. Course development is also going on within the Colleges of Education and Business and Public Administration. It is hoped that distance education courses will be offered in these areas within the next two years.

As the University continues to develop its distance education facilities and as new technology is developed and made available to Guam, The University's role as a bridge between high technology providers and carriers and low technology users will become increasingly significant. The experiments presently being conducted at the University of Guam will, hopefully, produce models that will have utility not only in American Micronesia, but in the rest of the developing world as well.

Session 5.2

Business Applications

NOTES

Video Teleconferencing at Offices and Factories

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ABSTRACT

Present status of videoconferencing in Japan and its evolution are presented in view of recent advances in network, codec and customer's premises equipment. Demànd for integrated visual stations are emerging which might be useful as a personal terminal for videoconferencing, and expected to expand their applicability in daily business meetings. Such recent trends are also discussed.

Teleconferencing makes it possible for geographically dispersed people to participate in conferences or meetings at their offices. It not only saves much time and expense for traveling thus increasing opportunity of participation, but also contributes to improving business activity and productivity.

Rapid progress in digital signal processing and expansion of digital networks make it possible to apply videoconferencing in various occasions of business activities at a reasonable cost. Appreciation for videoconferencing is steadily expanding in Japan mainly in business areas and in some cultural areas including education and training.

This paper presents recent trends of videoconferencing services and technologies in Japan, and then discusses expectation and prospect for the future mainly from the viewpoint of personal media of integrated visual communications.

1. Videoconferencing Services in Japan

Videoconferencing services are offered by Nippon Telegraph and Telephone Co. (NTT) in the domestic area and by Kokusai Denshin Denwa Co. (KDD) in the international.

1.1 Domestic Service

The domestic service in Japan is offered by NTT since 1984 and is now covering 16 cities. The number of videoconferencing systems connected to the network is 49 owned by 28 customers. Twelve rooms of them are of the public use type owned by hotels, building owners, local governments, etc. NTT does not provide any public room by themselves.

The service has been offered based on a compressed digital video of 6.3 Mbps at the beginning, which is now being replaced by 1.5 Mbps. Video codecs are of the original type developed by NTT and have no compatibility with the international standard. The service is a network service specialized for videoconferencing and codecs are provided by NTT. The network is utilized on an occasional basis by reservation. The terminating circuit connecting customer's equipment to an NTT end station is of the analog type video transmission.

Private videoconferencing systems which are installed by private organizations for their own use (intra-corporate use) connecting by dedicated high speed digital circuits are widely used in many business entities including electronics and computer manufacturers, automobile manufacturers, steel and heavy industries, finance and banking firms etc. More than one hundred systems are estimated in operation now. They are very effectively used among offices and factories and have become an indispensable tool in their business. Some of them are constantly used for more than 70 or 80 percent of business hour.

1.2 International Service

The international service was initiated by KDD in 1987 when IBS (INTELSAT Business Service) circuit was established between Japan and the USA. The service is nicknamed as 'VIDEO SESSION'. Two types of codecs are installed at KDD office, one meeting CCITT standard (GPT's codec) and the dominant one in the USA (CLI's codec). Terminating circuits to customer's premises is of analog type by optical fiber or local distribution radio (LDR) system.

The network configuration is shown in Figure 1. The service area is shown in Table below:

Table: Service Area of VIDEO SESSION

Domestic	Tokyo, Osaka
Foreign	USA (AT&T, US Sprint, HTC) F.R.of Germany, France United Kingdom, Switzerland The Netherlands, Italy Belgium, Singapore, Hong Kong, Taiwan Australia

The service is being offered at four public videoconferencing rooms in Tokyo and Osaka.

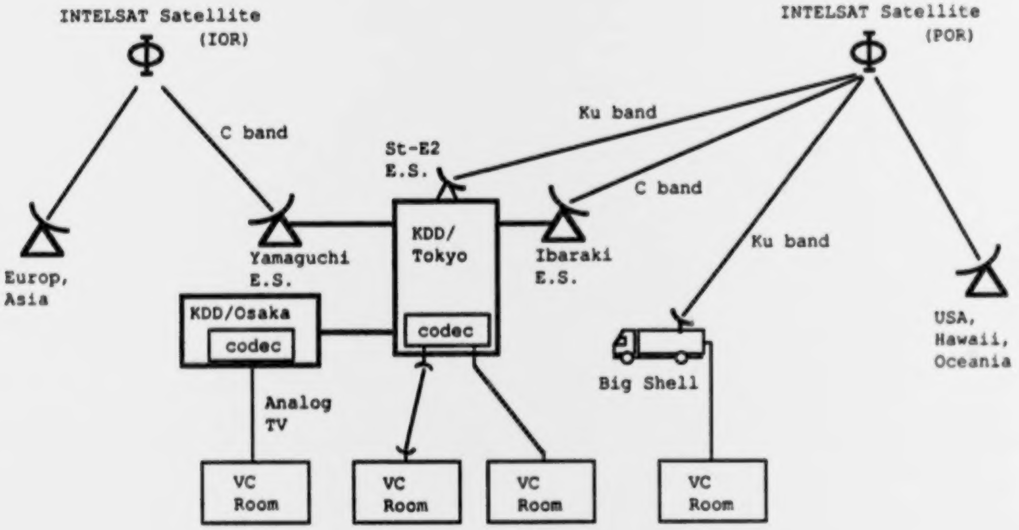

Figure 1 NETWORK CONFIGURATION OF VIDEO-SESSION

KDD Ohtemachi Office	Tokyo
VIDEOCOM International Corp.	Tokyo
Keio Plaza Hotel	Tokyo
Arc Hills (for members only)	Tokyo
Royal Hotel	Osaka

VIDEOCOM International Corp. (VIC) is a subsidiary company of KDD and offers a variety of visual communications services including videoconferencing. They have been operating a public room in their head office since September, 1987. The two public rooms in the hotels shown above are also provided by VIC. The great part of international videoconferencing in Japan has been offered at the VIDEOCOM's room and they have much experience in this field.

All the videoconferencing rooms listed above are of the public type. No private organizations have facilities connected to the international circuit yet.

Traffic volume of the service is still very small, though the use began to increase rather sharply especially among branch offices of foreign industries.

One of the urgent questions to accelerate the use is to expand service areas which is now restricted only to Tokyo and Osaka. As an effective solution to this, KDD is now planning to offer a small earth station, user gateway, for customers in local cities to access the international service. This earth station is installed at customer's premises and makes it possible to access INTELSAT satellite directly. The antenna is the Standard E-1 type for Ku band with the diameter of approximately 3.5 m.

Demand for videoconferencing at events, international conventions, symposia, memorial ceremonies etc. is increasing these days. For such an occasional use of videoconferencing, a domestic circuit especially the end portion to the event site is often a key problem. The LDR system is normally used for such a purpose.

Another way is to use a transportable earth station ('Big Shell') which enables to access INTELSAT satellite directly from an event site at any place in Japan with minimum cost and man-power. This transportable earth station meets the Standard E-1 specification (Ku band) with a 2.6m diameter parabolic antenna which is mounted on a truck. This earth station is capable to transmit and receive analog video signals and high speed digital signals. Equipment necessary for videoconferencing including a video codec is also equipped in the truck.

2. Evolution of Videoconferencing

As described above, videoconferencing services have started in Japan and understanding for their effectiveness is steadily expanding. Chances are increasing to apply videoconferencing in daily activities of business life. Traffic volume is, however, still very low and the tempo of growth is far slow than expected.

Some private systems for their corporate use are very effectively used. In these cases, intensive use of such systems is expanding their applicability and effectiveness. They are, however, rather restricted examples.

For further growth of videoconferencing and taking off as a major telecommunication service, wider penetration into offices as a daily business tool should be aimed. The most importance in this regard is:

a) Increasing utilities and effectiveness

This include, but not all;
-expanding digital networks
-establishing end-to-end compatibility
-providing a variety of facilities

b)Reducing cost

This include;
-terminal equipment cost
-communications charges

Key factors affecting these basic requirements are discussed below.

(1) Network

High speed digital network is indispensable for visual communications. Most videoconferencing services offered now are using primary rate of digital path (1.5 or 2.0 Mbps). This will, however, become diversified depending on user's requirement for quality, cost, network availability etc. In some applications, even 64 kbps digital path will be applied for videoconferencing.

Most traffic of videoconferencing at present is handled by either;

i) dedicated digital circuit, or
ii) public videoconferencing network.

The alternative i) will continue to apply as a cost effective solution for users with heavy traffic to some specific partners, typically intracorporate videoconferencing. It is also an important advantage of the dedicated systems that rather sophisticated functions could be implemented according to specific requirements of the users.

The alternative ii) above is offered now in many countries and used on an occasional basis by reservation. In most cases, video codecs are provided by or specified by carriers, thus keeping end-to-end compatibility. This type of network is, however, rather inflexible and restricted in coverage of network, and will be gradually replaced by new network, ISDN.

iii) ISDN

ISDNs are being introduced extensively in many countries on a commercial basis and they will play a key roll for a wider spread of the visual communications to general public. In Japan, the domestic service of ISDN at a basic rate (2B+D interface; 64 to 128 kbps) has started in 1988 and at a primary rate (23B+D interface; 384 kbps to 1.5 Mbps) in 1989. The international ISDN at a basic rate has inaugurated 1989 between Japan-US and Japan-UK.

It should be noted that communication charges for these services are set to relatively low level, especially in case of the basic access. The charges for one B-channel are as low as those for conventional telephone call. This means, videophone call with full color motion video on a switched basis has become possible in a similar cost and convenience to normal telephone by the ISDN.

(2) Compatibility

For evolution of the service, it is essential to establish end-to-end compatibility among terminals. Compatibility is required on various levels and it becomes more complicated with increasing sophistication of facilities provided. Establishing a basic level compatibility should be aimed at the first priority.

As far as motion video is concerned, the compatibility problem will be almost solved soon by approval of CCITT Recommendation H.261 for Px64 kbps video codec and relevant Recommendations. International compatibility test by Flexible Hardware of H.261 codec was successfully carried out last fall and it is certain to reach the final agreement coming spring.

There remains many items yet to be standardized to provide enhanced facilities; but it should be noted that the basic level of compatibility will be ensured by these standards. This is an important step for development of videoconferencing as a world wide public service.

Commercial products of codec based on these new standards are scheduled to be supplied from this summer on by many manufacturers. New generation of such codecs with reduced price is expected to stimulate the growth of videoconferencing market.

(3) Customer Premises Equipment

Compact videoconferencing equipment is increasing in business applications. Devices such as cameras, monitors, audio devices, system controller are installed in a cabinet with castors and it is transportable ('roll-about'). It does not require a dedicated room in particular. Price of equipment is decreasing remarkably.

For business applications of videoconferencing, remote presentation of documents, photographs or real samples is indispensable. Real time transmission of written materials will be also required. Basic technologies for such high resolution graphics and telewriting are established. But since user's requirements in this regards vary widely, importance is how to combine such facilities, how to use or operate them, how to implement in real equipment. International standardization for such advanced functions is now going on as an urgent question.

Users tend to demand videoconferencing systems similar convenience as office machines such as facsimile, word processors or document work stations. Their requirement for performance and operability of the system is severe. They want to use them nearest by in their offices. This trend will lead to an idea of personal visual stations, which will become a promising market and is discussed further in the next Section.

Terminal cost is now the most dominant factor for the growth of videoconferencing. Adequate standardization often accelerates wide spread of terminals into public, which, in turn, decreases terminal cost much more. The recent progress in standardization of video codec is expected to bring a chance of such a rapid growing process.

It may be interesting to note a drastic increase of facsimile machines taking the opportunity of the standardization of G3 facsimile in 1980. Before that time, facsimile machines were very expensive, similar level as videophone set at present, which prevented wide spread of the machine. Popularization of facsimile after then is admirable with decreasing price and increasing benefit.

3. An Approach to Integrated Visual Station

3.1 INVITE 64

Seeing-while-talking has been a dream of mankind. Visibility helps intuitive grasp of nature and is effective for accurate exchange of information and opinions. An idea of a videophone is as old as the invention of telephone about 100 years ago. Toward this end, a number of trials has been undertaken in spite of many technical and operational difficulties. By virtue of progress in ISDN and advancement in digital signal processing, however, the environment for videophone has been rapidly changing.

The basic part of the dream is being realized by videoconferencing on a commercial basis. They are forming an important part of office and factory innovations.

Nevertheless to say, the basis of communications is voice (telephone) and visual information is needed as supplementary media to telephone conversation. Therefore, the basic user's requirement is visual communications as an extension of a telephone call. This means, they should be;

-as easy to use as telephone,
-available at any time by simply dialing a number,
-not so expensive compared to telephone.

It is quite a natural tendency to demand a videoconferencing in their nearest place without reservation in advance. In the end, it is a personal visual terminal at desk side or desk top. In some cases, it might be a simple videophone. In another case, it might be an 'integrated visual station' which is a personal media to provide not only audio and motion video capabilities but also text and graphics handling capabilities.

Aiming at such a personal station of integrated visual communications, KDD has developed INVITE 64 system in 1985 by applying state-of-the-art audio and video signal compression technologies. It has demonstrated at the first time that transmission of both audio and full color motion video is possible over a single 64 or 56 kbps digital circuit.

INVITE stands for integrated visual telecommunications and has capabilities not only audio and motion video but also still video, digital facsimile and text handling as option (see Figure 2). It meets various requirements; a simple videophone, an integrated visual station or a compact videoconferencing system.

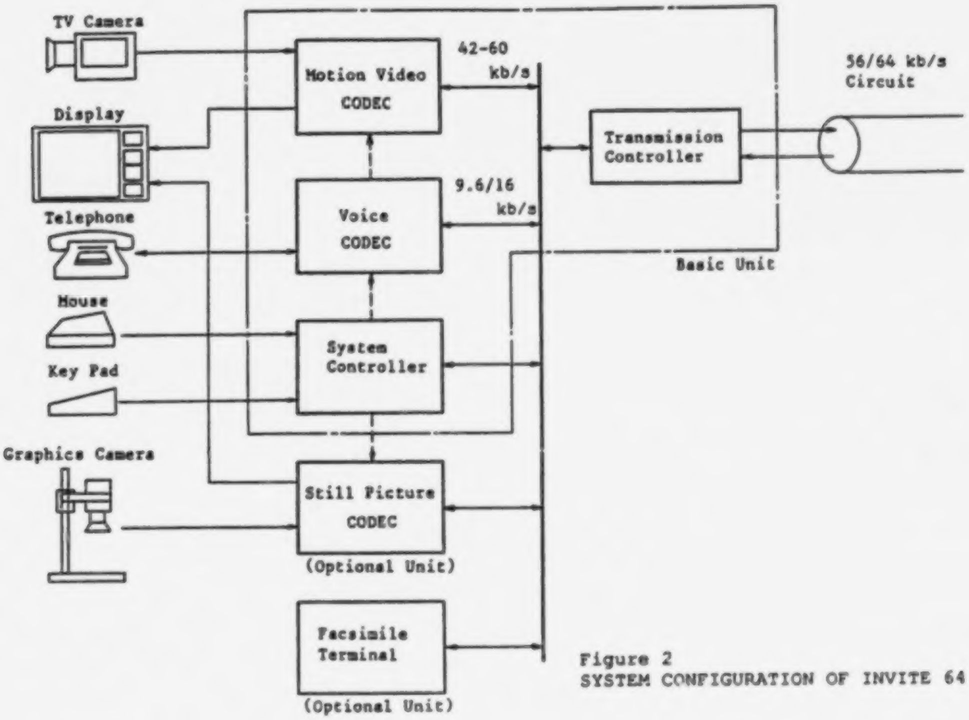

Figure 2
SYSTEM CONFIGURATION OF INVITE 64

The key technology is a low bit-rate audio and video codec operating at a speed as low as 64 kbps. Progress of such a low bit-rate codec is remarkable in the past several years and many commercial products are available now in the market. By applying these low bit-rate codec, various types of integrated visual stations are becoming available in the market.

The standard for Px64 kbps codec described above will accelerate this trend much more.

3.2 Experiment of Visual Station

(1) Purpose

Lack of attractive applications may be cited as one of the major reasons why videophone business never have taken off in spite of substantial effort in hardware development and sales activities in the past years.

KDD has conducted an extensive field trial of INVITE system between Tokyo and New York City with an aim to seek for viable applications of the videophone from September, 1988 to March, 1989, assisted by VIDEOCOM International Corp.

An INVITE system equipped with motion picture and still picture functions with G4 facsimile and video printer was installed at the Imperial Hotel in Tokyo and the Penta Hotel in New York. A dedicated circuit of 56 kbps was set up between the two hotels.

Considering the time difference between the two cities, the trial was made from 9 to 10 o'clock, Tokyo time, corresponding to 7 to 8 o'clock in the evening in New York. Several events are planned on special occasions like Christmas day or St.Valentine's day, etc.

(2) Analysis of Experimental Results

Questionnaires were given to those participants of 1,505, from which 1,103 people (67%) responded. The following is a brief summary of the analysis.

a) Comment on the Trial

Figure 3 shows the summary of the comments given by the participants. About 90% of them expressed their satisfaction with the experience, honestly saying 'interesting', 'wonderful' and 'beautiful picture' etc.

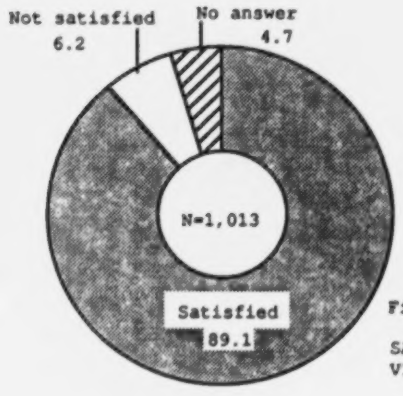

Figure 3

SATISFACTION TO VIDEOPHONE TRIAL

b) Evaluation of Videophone

As is shown in Figure 4, about 74% ranked the picture quality as 'good' or 'fair', while about 22% said it 'poor'. The more intimate the relationship between the two parties, the better the evaluation of picture quality.

Concerning the audio, similar comments were given. Business oriented people gave rather severe comment. Among the criticisms against voice quality, delay of voice was one of the most concerned.

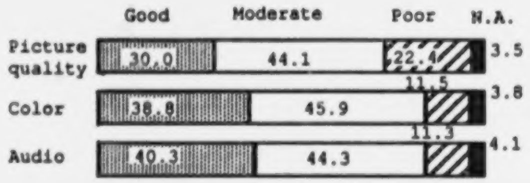

Figure 4 EVALUATION OF QUALITY

c) Intention of Further Use

About 42% expressed their intention of use it again by all means, while about 45% said that they may use it if a chance is given.

d) Charges and Prices

As to the charges for using public videophone booth in the future, 65% people said they will use it if the charges are cheaper than twice the conventional international telephone call. The 70% said that they may buy the equipment for themselves if it is less than ¥1,000,000 (US$7,200).

4. Future Prospect

The key factors to implement a videoconferencing system are the digital network, signal processing (coding/decoding) and terminal equipment. As described in this paper, environment of videoconferencing is rapidly progressing. Customers are becoming able to construct a wide variety of systems depending on their requirements and be able to use them in a form most appropriate to each application.

Basic trend of evolution of videoconferencing is summarized as follows:

1) Network

Network condition is developing much favorably for videoconferencing and will continue to expand. Most requirements will be satisfied by either dedicated digital network or ISDN. A variety of bit rate provided by ISDN will make it possible to implement the system most appropriately to user's application.

Coverage of ISDN is still rather restricted now, but steady expansion of the network is planned in each country with highest priority. In the midst of the expansion, a hybrid of the dedicated network and ISDN might increase availability.

2) Codec

Adoption of the world standard H.261 for motion video coding will make sure the basic level compatibility among systems in the world. This is an epoch-making step for wide spread of videoconferencing to public. A wide range of bit-rate covered by the standard (64 kbps to 1.5/2.0 Mbps) will meet a variety of visual communications requirements.

Many items including high efficiency audio coding, audio-graphics teleconferencing etc. remains for further study. They are also indispensable for enhanced videoconferencing and early standardization is truly expected.

3) Terminal Equipment

A variety of terminal equipment is available now; a deluxe type which conforms to official meetings, a rather compact type (roll-about) for daily meeting or personal type on desk-top etc.

A demand is increasing for personal stations of visual communications including videophone. This is becoming realistic now at a reasonable cost thanks to recent technology development. It will expand the possibility of applying videoconferencing in every occasions of daily activities.

4) Cost

Availability of videoconferencing system in accordance with customer's requirement is expanding. Cost is now the most important factor for taking off of videoconferencing business. Communications charges have become relatively low by ISDN, essentially the same as conventional telephone call in Japan. The remaining question may be the price of hardware.

As was shown in the previous Section, users have intention to buy videophone if the price becomes less than ¥1,000,000. Explosion of real demand is conceivable with decreasing price below a certain level as in case of office machines such as facsimile or word processor.

5) Network Facilities

Requirement for enhanced facilities will increase. They will be realized mostly by terminal equipment and partly by network oriented facilities. An example is multipoint videoconferencing which might be realized as a network facility provided by network providers or by users themselves. In such a multipoint environment, different kinds of terminals including videophone are required to be connected each other and provision of interworking or conversion might be necessary to be made.

The atmosphere for video communications is being matured world wide. It is believed that this tendency will continue to proceed, and that videoconferencing will become one of the indispensable business tools in a few years.

ACKNOWLEDGEMENT

The author wish to express his gratitude to Dr. Satoh, President of VIDEOCOM International Corp. for his helpful advice .

CORPORATE BUSINESS TELEVISION NETWORKS

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ABSTRACT

Private business television networks are increasingly being installed to deliver information, training, and motivational messages to large audiences in widely dispersed locations. These permanently installed one-way satellite broadcast networks, used to reach employees as well as customers and other external audiences, are increasingly taking root, especially in the U.S., Western Europe, and Japan. Employing fixed or transportable uplinks and small receive-only earth stations operating in the Ku frequency band, business television networks are expected to experience continuing growth in the 1990s.

INTRODUCTION

As businesses strive to remain competitive, to stay in touch with the remotest parts of their ever-changing organizations, to be responsive to customer needs, and to be perceived as innovative and effective, they are increasingly considering the use of business television. A combination of live television and the practical delivery afforded by Ku-band satellite networks, business television has shown strong growth in the last several years and will increasingly become a part of business communications in the 1990s.

Originally a U.S. phenomenon, several business television networks are now operational in France, The Netherlands, the United Kingdom, Canada, and Japan. The U.S. experience has proven to be a useful model for emerging networks and this paper, based on recent research conducted by KJH Communications, summarizes the nature of the U.S. networks with a look at what can be expected elsewhere. (1)

THE CONCEPT

Unlike digital videoconferencing, where small groups of people at one site see and hear small groups of people at other sites, business television is a uni-directional transmission of a video program from the origination point to multiple receive sites. Unlike digital videoconferencing, which uses terrestrial or satellite networks and user-operated conference rooms to create an interactive discussion environment for a small number of sites, business television relies almost exclusively on satellite communications to disseminate information, training, and motivational programming to large audiences often numbering in the thousands. Viewers are not seen but are often able to participate through telephone connections to the on-camera presenters.

Business television networks take two major forms. *Private* networks are owned by and operated for individual user organizations; their programming is specific to the user's needs. *Programming* networks offer subscription services to a number of users, who are in a single industry or who share a common subject matter interest. Programming is generic to that industry or interest. Specific examples include networks that provide continuing education for the medical professions, sales training for automobile dealerships, racetrack and other sports results for betting parlors, distance learning for children in remote geographical areas, programs on the computer industry for information services managers, and training for law enforcement agencies.

While the programming network is a useful tool for education and training purposes, it is the private network that has the potential to make the most difference in the way corporations operate their businesses.

THE ENVIRONMENT

The nature of business television has changed over time to reflect improvements in technology, changing governmental regulation, and increased understanding of the uses of television for private communications.

The first permanent corporate networks grew from experimentation with temporary networks in the late 1970s and early 1980s. Using transportable earth stations that operated at C-band frequencies, early users of business television broadcast product announcements and management messages to widely dispersed sites, set up temporarily in hotels and other public areas. Some of the early users recognized that they could cost justify a permanent network, with earth station equipment installed on or near their own premises.

The feasibility of permanent networks and the economic case for installing them were greatly improved in the United States with the introduction of Ku-band technology and the governmental deregulation of telecommunications in the early 1980s. The smaller Ku-band earth stations mitigated to some extent the concerns of environmentalists and local zoning authorities. The Ku spectrum, limited to satellite applications, facilitated installation of downlinks on most user premises, even in heavily populated areas. Deregulation encouraged the launch of new satellites which provided readily available capacity at very low prices and provided a fertile environment for entrepreneurial service companies that would develop the market for private networks.

From a few pioneering networks beginning in the early 1980s, private corporate networks in the U.S. grew to almost 50 by the end of 1989 and included such global companies as American Express, Apple Computer, AT&T, Digital Equipment Corporation, Eastman Kodak, Federal Express, Ford Motor Company, Hewlett Packard, IBM, Xerox Corporation, and many others. Several of these U.S. networks have extended the reach of their networks to permanently installed sites in Europe, and will continue to do so. A handful of private European networks began operation in the late 1980s. The "1992" movement has increased the need for business communications; and the deregulation of receive-only earth stations and other supporting legislation has further set the stage for the development of service organizations to support the growth of business television networks.

It is in Japan, however, that conditions today most closely approximate those that were responsible for the birth of private business television networks in the United States. Increasing competition in telecommunications, widespread comfort with communications technology, and the existence of several satellites with capacity available for business broadcast services combine to form a ripe environment for users and suppliers. Among the latter, Skynet Communications, Star Communications, Telecom Sat Co. Ltd., and Videosat are developing networks on JCSat-1, launched in March 1989 and owned by C. Itoh & Co. Ltd. and Mitsui & Co. Ltd., two of the largest of the Japanese trading companies, and Hughes Communications of the U.S. Supernet, Inc., is actively establishing private networks on Superbird, a hybrid satellite launched in July 1989 and owned by a consortium that includes Mitsubishi companies as major shareholders. Despite the relatively recent availability of capacity for business television networks, several Japanese corporations are already actively involved as business television users.

In other areas of the world where satellite capacity is available for private networks, business television is increasingly explored. And the number of networks in the U.S. continues to grow.

PRIVATE NETWORK PROGRAMMING

The primary characteristic of U.S. business television is the "live" nature of the programming. Fully 85% of all program hours aired on private networks originate live, and only 15% result from pre-taping. Some programs originate on location and a growing number from on-site interactive digital videoconference facilities, suitable primarily for programs that do not require high production value.

Programs most often originate in user-owned or leased studio facilities using professional television equipment and a production staff knowledgeable about television. Program participants may have received some coaching to improve their on-camera performances, but in most cases they are first and foremost business people whose real talent is developing products or managing the business. They appear on camera not to win ratings but to communicate with employees and customers, the press and the public. With less than a quarter of the content fully pre-scripted and extensive use of audio feedback from the audience, business television programming is notable for its "realness".

To date, the majority of programs are produced for internal audiences and have as their objectives the dissemination of information, the training of field personnel, and the motivation of employees.

Informational programs account for the 61% of all programs produced. These programs include news shows, new product/service introductions, product/service updates, competitive or industry reports, management messages, general education, administrative information, and management meetings. Programs in this category range in length from short 5-minute news programs to lengthy presentations, and average 80 minutes across all networks and all program types.

Training programs account for 29% of all programs produced. They tend to be longer than informational programs, averaging 3 hours and sometimes filling an entire day. As a result, training programs account for the greatest number of program hours produced. Training programs are those that provide skills to directly improve the job performance of people within the organization. Typical programs focus on technical, sales, management, and communications skills.

While all programs contain some motivational value, a few programs are produced that are primarily motivational in nature. These programs include sales/marketing kickoff programs or celebrations, organization loyalty and team building programs, and health and wellness programs. Purely motivational programs are a small portion of overall business television programming.

Organizations also use business television networks to reach external audiences. In 1988, programs created exclusively for customer audiences accounted for 7% of the total programs produced and 7% of the programming hours. These numbers will likely increase in the next several years, as networks mature and expand their focus beyond employees. Typical customer programs include new product/service introductions, product/service updates, and technical training.

In addition to customer-oriented programs, networks also produce some programs for other external audiences, including the press, financial or industry analysts, shareholders, and the like. These programs may be as short as a 30-second spot designed for use in commercial television broadcasting or considerably longer for meetings and reports.

NETWORK COMPONENTS

Sizes of U.S. private networks range from a dozen receive sites to several thousand. Several of the networks were originally implemented as VSAT data networks with business television as an added function.

All corporate networks operate in the Ku spectrum. The receive portion of the network usually consists of 1.8-meter fixed antennas and associated non-redundant electronics. Since the programming may contain information sensitive to the user organization, networks usually scramble their programming to prevent unauthorized viewers from tuning in. Most-used is the Scientific Atlanta B-MAC system. B-MAC decoders and satellite receivers (increasingly implemented as integrated receiver/decoders) are typically housed in cabinets or consoles that contain a television receiver, video monitor, or projection system as well as a video cassette recorder (VCR). Total price of downlink systems, including satellite receive equipment and display equipment, is usually US $10,000 or less, installed.

The transmit side of the U.S. networks is more diverse. The program is transmitted either on an uplink dedicated to the user or on a shared uplink. The majority of the dedicated uplinks have been installed on the user's premises. In addition to being cost effective for users with substantial amounts of programming, users believe that dedicated uplinks offer increased reliability and security and greater scheduling flexibility. A minority of those with dedicated uplinks have off-premises uplinks operated by others or they own their own transportable uplinks. In contrast to users with dedicated uplinks, users that rely on shared uplinks generally have fewer hours of programming. The majority have a full-period microwave connection from a studio to a teleport where they reserve uplink facilities as needed. Others rely on vendor-supplied transportable uplinks.

Ku-band satellite capacity, currently selling at US $700-900 per hour, is available on several satellites. Most-used by the private networks are GTE Spacenet's G-Star 2 and GE Americom's K-1 satellites. Private networks average around 20 hours of satellite time per month.

Since the early 1980s, several organizations have emerged to assist users in designing, installing, operating, and maintaining their private business television networks. Operational assistance includes operating uplinks and encoders, transmission quality assurance, day-of-air support for receive sites, and operational reporting. Maintenance plans are designed to resolve troubles at the uplink and downlink sites and are customized for the individual user based on the user's system availability requirements.

MARKET SIZE

The U.S. market for goods and services associated with private network business television was US $120 million in 1988 and is expected to surpass $230 million by 1990. While the U.S. market represented probably 90% or more of the worldwide market for private networks in 1988, by 1990 there will be considerable growth in private networks outside the U.S. Some of these will be European or Asian subsets of American networks, but far more will be those owned by European or Asian business enterprises. Growth will be particularly strong in western Europe as a whole and in Japan.

While the concept of reaching far-flung business outposts in a single broadcast is appealing conceptually and can be accomplished technically, differences of time zones, language, culture, and business practices make such broadcasts rather impractical for all but a few applications. Networks will likely develop primarily as regional rather then global networks with capabilities for creating and transmitting programming to geographical and cultural subsets of global corporate audiences.

THE FUTURE

Private network business television has enjoyed steady growth during the 1980's, with considerable activity in the last year. The next several years will see the following characteristics of this still relatively new industry:

- Continued steady growth in number of networks.
- Penetration of networks in industry segments not yet represented.
- A small amount of fall-out among users unable to sustain the resources necessary to operate a network.
- Increased size of networks, to a great extent influenced by the construction of large data/video combination networks.
- Greater amounts of programming transmitted, in a wide variety of program formats.
- More programming for external audiences.
- More cross networking to other private networks.
- Changing roles of suppliers as they position themselves competitively for supplying equipment and services to a growing worldwide market.

Notes

(1) *Private Network Business Television: A Market Analysis*, Copyright 1989, KJH Communications.

OPTIMUM ONLINE NETWORKSYSTEM WITH ARTIFICIAL INTELLIGENCE

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1. ABSTRACT

This paper introduces CDNSⅡ, the AI system for online network design.

2. INTRODUCTION

2.1 What is CDNSⅡ ?

The CDNSⅡ is an online network design, Fujistu's network design tool development group began designing The CDNSⅡ in 1987, and began to use it in April 1988. The CDNSⅡ was designed to make basic network design quick, efficient, and reliable. Information required for online network design is entered in conversational mode at a computer terminal, CDNSⅡ quickly designs the best point-to point and multipoint online network, and output eight kinds of list such as a network configuration diagram, line configuration table, and cost table. The most conspicuous feature of CDNSⅡ is that AI is used for mulitipoint design, a task which used to be too difficult for computers because of the almost infinite nummber of network combinations. With AI and CDNSⅡ, this task is now both feasible and quick.

2.2 SCOPE

CDNSⅡ designs online networks as described below.

(1) Network type

Start-type network with a central host computer (including multipoint line for leased line)

(2) Applicable lines

(i) Switched line

DDX-C (1200, 2400, 4800, 9600, and 43,000 bps)
DDX-P (200, 300, 1200, 2400, 4800, 9600, and 48,000 bps)
DDX-TP (200, 300, and 1200 bps)
Telephone network (200, 300, 1200, and 2400bps)

(ii) Leased line

Band (3.4kHz, 3.4kHz(s)/1200, 2400, 4300, 9600, and 14,000 bps)

Code (1200,2400,4800, and 9600 bps)

(3) Range oh charge

Between DCE and DCE. The monthly charge (line charge, MODEM /DSU charge) and initial charge are calculated. The modem charge includes lease charge.

3. BACKGROUND OF CDNS Ⅱ DEVELOPMENT

3.1 Current Network Design

Network design is roughly divided into the three processes below. These processes are currently done manually.

(1) Collection and analysis of design information

Prior to design, the information below must be collected and processed.

- Position of terminal and host
- Data length (to host, to terminal)
- Number of data items that each terminal must process
- Processing type (inquiry, concentration/distribution)
- Response time
- Allowable lost call factor
- Concentration factor at the busiest time

(2) Design of online network capabilty

The network must satisfy the two conditions below.
- The response time of one transaction must be within the response time requested by the customer.
- A transaction that occurs at the busiest time must be processed within the specified time.
We calculated the transmission speed and line service that satisfy the above conditions.

(3) Optimization of online network

The network obtained in (2) is not economical because in some terminals only few transactions occur and these terminals do not use the line capacity efficiently. We considered use of multipoint lines and a time-division multiplex system to reduce the line cost to satisfy the conditions listed in (2) above.

3.2 Current Problems and Solutions

Communication has been rapidly deregulated since the Telecommunications Business Act was revised in 1985. Some of the elements that make up an online network are listed below.

- Line services (DDX-P, DDX-C, high-speed digital line, INS)
- Line carriers (NTT, NCC, VAN)
- Communication protocols (BSC, HDLC, X.25)
- Network type (multipoint, multiplex, packet switching)

Online network designers must find the best network by combining the design information described in the previous section and the above elements. However, network designs are becoming less reliable because there are not enough designers to cope with the increased workload accompanying the rapid progress in network technology.

We deveroped CDNS Ⅱ to improve the reliability of network design and reduce the designers' workload.

4. DEVELOPMENT OF CDNS Ⅱ

4.1 Development System

The CDNS Ⅱ uses AI and a knowledge database to design networks. To genarate the above database, designing methods had to be learned from network designers. The processes up to system design were desigoed jointly by network design experts and knowledge engineers. Programming and testing were done by knowledge engineers and programmers. Figure 1 shows the development organization.

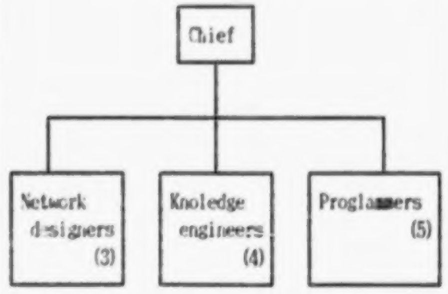


Figure 1

4.2 CDNS Ⅱ features

We developed CDNS Ⅱ to allow users to design networks efficiently and reliably. CDNS Ⅱ provides the features below.

(1) Application of AI

The knowledge of network design experts is accumulated in a database to reduce processing time and to ensure consistent network design.

(2) Maintenance

Information which may change is stared in the database so that maintenance can be performed easily even if the carriers' line charge is revised.

(3) Design information defaults

Design information is not always complete dualling actual network design. We provided defaults so that network can be designed even though the design information is incomplete.

The next and subsequent sections describe the application of AI and the design knowledge database.

4.3 Applying AI

(1) Limits of conventional methods

When a host and terminal are connected point-to-point, the optimum network can be found easily although it will take a lot of man power. To connect the host and terminals point-to-point, we need to only select the most economical line which satisfies the customer's data capacity and data rate requirements. for connection of a multipoint line, if the line between the host and terminal A must branch to terminal B, the following must be considered:

- The line processing capability must not be exceeded.
- The number of branches specified by the carrier must not be exceeded.
- The data rate requested by the customer must be satisfied.
- The line cost must be reduced.

The line can be branched as long as the above conditions are satisfied. If additional branching is not possible on that line the next line is used. By branching all lines, a network with a low line cost is achieved, but whether this network is the best remains unclear. There are some cases in which the cost is lower if terminals are connected to another line instead of branching them to the same line. Therefore, the overall balance must be considersd. This process can be handled by a computer using a conventional language processer, but this places an enormous load on the CPU. For example, if a leased line (9600bps or 4300bps) and DDX-P (3600bps or 4800bps) are used and the leased line is branched to four points to accomodate 10 terminals there are 46,932,984 conceivable network combinations.

(2) Application of AI

Needless to say, the network design expert dose not consider all the above combinations. The designers networking knowledge allows him to quickly eliminate the majority of patterns as unworkable. The CDNS Ⅱ, using AI and a knowledge database, works in the same way.

4.4 Multipoint Design

This section describes how CDNS Ⅱ searches terminals to be branched for the optimum network.

To consider branching, a network in which a host and a terminal are connected point-to-point must be designed in the initial state. Increasing the number of branch points reduces the network cost.

(1) Search 1

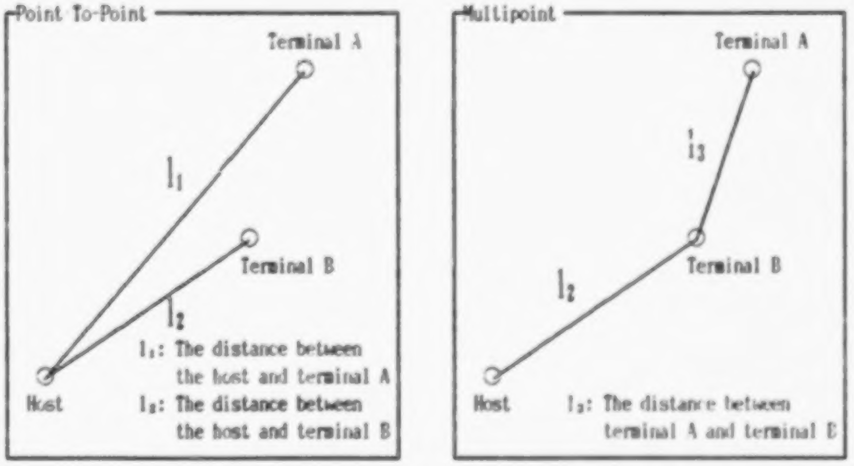
- Branching starts at the terminul located furthest from the host

The line charge increases in units of distance segments set by NTT. The distance is calculated on NTT's block table. For a multipoint line, each distance between the host and terminal B then between terminal B and terminal A is calculated. The line cost is calculated on the total distance according to the distance segment. If this distance segment and the distance segment to which the host and terminal A belong are the same, the cost is lower for the part between the host and terminal B. Actually, the multipoint line charge and the multipoint line cost must be paid. The further the terminal is from host the cheaper the line charge. Branched terminals are searched from the one furthest from the host. Figure 2 shows the method of calculating the line cost.

(2) Search 2

- Search up to the limit where the line charge is cheaper than that before branching

Depending on the position of terminal B to be branched, the line charge rank of the distance segment after branching may be higher than that of the distance segment between the host and terminal A. As a result, the line charge after branching may be more expensive than that before branching. To avoid this problem, we specified a search area so that terminals are searched only whithin the range where the cost was lower. We further divided the search area into the following areas: an area in which the distance segment is not changed even if terminals are branched, an area in which the line charge rank of the distance segment increases by one, and an area in which the rank of the distance segment increases by two. When a line between the host and terminal A is branched to terminal B, the search area is divided into an area in which terminal A and terminal B have a segment of the same distance, and an area in which the segment of terminal B is shorter than that of terminal A, terminals were searched from the area that has the lower cost. Figure 3 shows the area and the order of searching the terminal to be branched.


Point To-Point
Terminal A
l_1
Terminal B
l_2
l_1: The distance between the host and terminal A
Host
l_2: The distance between the host and terminal B
Multipoint
Terminal A
l_3
Terminal B
l_2
Host
l_3: The distance between terminal A and terminal B

The line cost is the total of each line charge.

The line cost is calculated on $l_{2,3}$ according to the distance segment. ($l_{2,3}$ adds l_2 and l_3.)

Figure 2

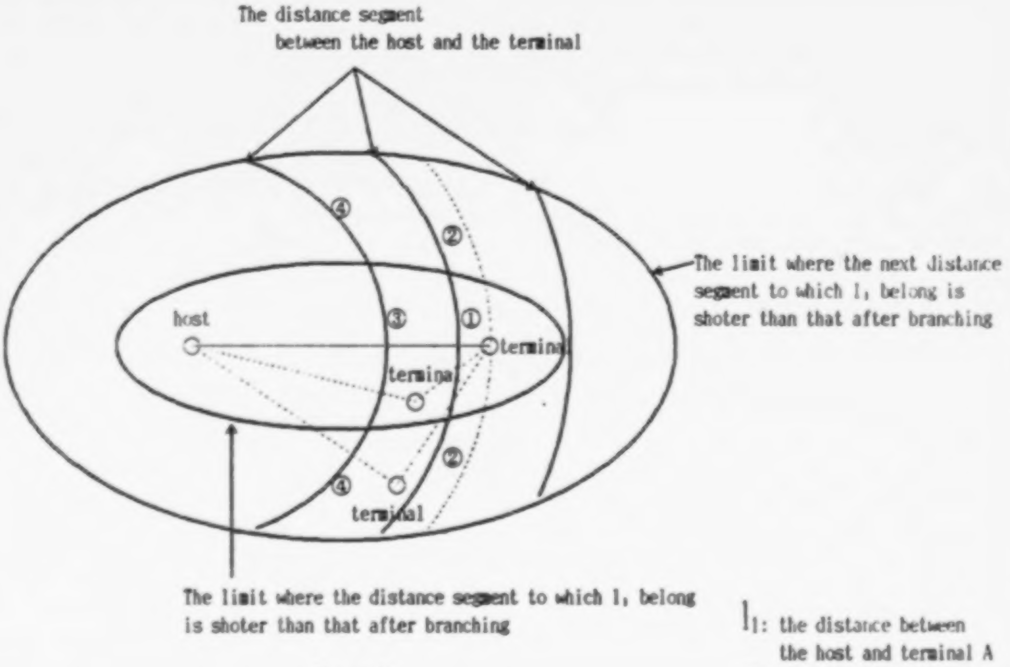

The distance segment between the host and the terminal
④
②
The limit where the next distance segment to which l_1 belong is shoter than that after branching
host
③
①
terminal
terminal
②
④
terminal
The limit where the distance segment to which l_1 belong is shoter than that after branching
l_1: the distance between the host and terminal A
①: the searched order

Figure 3

(3) Selection

When a line between the host and terminal A is branched to a different terminal, there are two search methods: terminals to be branched are searched without changing the line speed between the host and terminal A from the initial value, and the terminals are searched whith a speed higher than the initial value. Which method is better depends on how far the terminals are distributed. In CDNS Ⅱ, more than one line speed is provided for a multipoint line. As branching progresses, more network patterns are made, but when they are compaered in terms of the line charge, the lower the cost the slower the speed. We selected some network patterns with a cost advantage and continued to search terminals to be branched from the selected patterns. Figure 4 shows the relation between the lines cost and the numbers of the branched terminals

5. EVALUATION

5.1 Verifying Capability Using Model System

To evaluate CDNS Ⅱ, we compared a model system designed manually with a design by CDNS Ⅱ.
Design was done under the following conditions: 10 stations were provided for the model system. The response time was set to five seconds. DDX-P (4800 bps or 9600 bps) and 3.4 kHz (4800 bps or 9600 bps) lines were used. For manual network design, four designers with different abilities were selected.
One of the four designers designed the same network as that designed by CDNS Ⅱ. The line charge of the networks designed by the other three designers was more expensive than that designed by CDNS Ⅱ.

The designer by CDNS Ⅱ required 1.5 hours. The four designers required between 5 to 10 hours.

When 30 stations were provided, CDNS Ⅱ required 2.5 hours. The designers required between 10 to 24 hours and there was a considerable difference in the accuracy of network design. From these results, we confirmed that a CDNS Ⅱ design is quicker and more accurate than a manual design.

5.2 System Application Example

Almost 200 networks have been designed by CDNS Ⅱ for the OSAKA district. About half of these networks are in actual use. From our study, we can say that our initial aim, to make design efficient and reliable, has been fulfilled.

6. FUTURE WORK

CDNS Ⅱ has shown its effectiveness in network design, particularly for branching. In the future, we are planning to adopt the following items to create an expanded network design tool.

(1) ISDN

In April 1988, NTT started an ISDN service which is cheaper than the conventional public line service and enables high speed communications. Now that the ISDN has entered the market, the network configuration will greatly change.

(2) Mesh network

As the network is being expanded, higher reliability of the network is demanded. To secure reliability, more and more companies are using the mesh network.

(3) Multimedia network

Instead of indivisual networks for voice, fax, and other media, high-speed digital networks carry integrated media. It is necessary to integrate CDNS Ⅱ with TDNS, which is being operated as a design tool for voice networks.

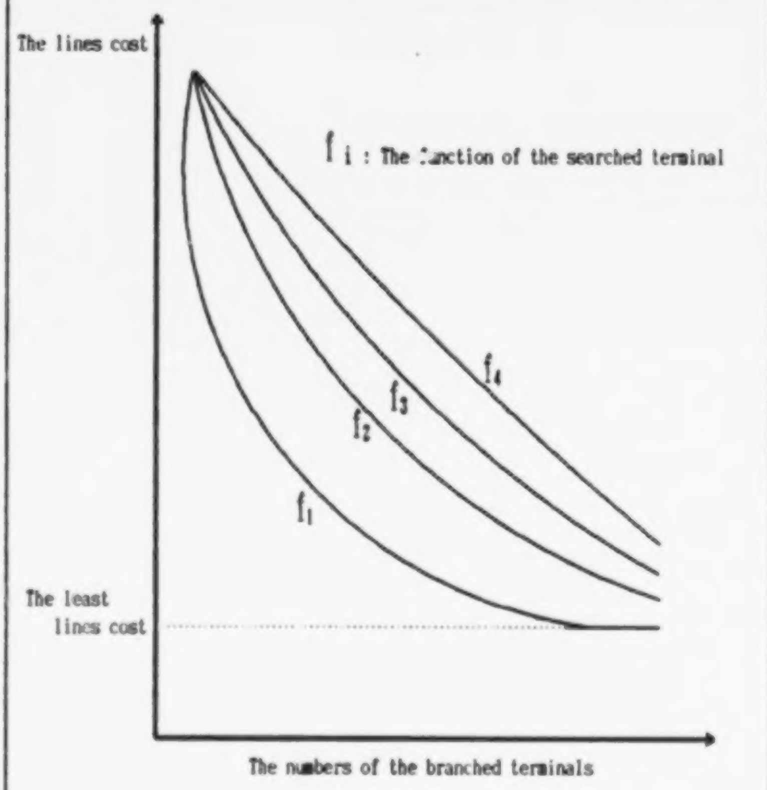


Figure 4

FUNCTIONALLY INTEGRATED VOICE AND DATA:
THE TIME HAS COME

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ABSTRACT

Computer Integrated Telephony provides direct benefits to the user by integrating services provided by the voice switch with applications running on the computer to bring knowledge to the telephone user and support realtime activities. The CIT platform provides an efficient and comprehensive set of tools for the software developer creating applications that incorporate and encourage the use of ISDN services. CIT technology is advantageous for the regulated and unregulated public utility market segments.

AN UNREALIZED DREAM

For many decades, the telephone has been an indispensable tool in every type of industry. The phone links the business to the outside world: to vendors, to customers, and to prospects who may become future customers.

In recent years, data processing has begun to rival the telephone as a business tool. Almost every kind of company, big and small, has come to rely on computerized information systems, from the mainframe-driven financial management systems of a merchant bank to the multiplant manufacturing systems of an aerospace company to the PC-based accounting system of a small retailer.

What could be accomplished if these two powerful tools--the telephone and the computer--could be made to work together? The communications industry has been asking this question for more than a decade. While some progress has been made toward eliminating redundancy of equipment and personnel in data and telecommunications, the functions have remained separate.

Part of the reason lies in the focus of communications integration in the past. Much technical effort has gone into consolidating phone and computer service at the physical level--the level of the wire. Coordinated wiring schemes, wall outlets, connecting jacks, and even integrated voice/data terminals have appeared. While physical consolidation can be a cost-effective measure in some new facilities and installations, it does nothing to make the phone and the computer system work together to achieve the benefits of synergy between the two technologies.

Neither has this synergy resulted from efforts to integrate telephony and data processing functions at the people level. Often these efforts were top-down edicts to cut expenses and reduce overhead by consolidating staffs. Sometimes economies were realized, other times they weren't. Often the consolidation resulted in disrupted service and reduced morale of departments and managers who feared loss of control and reduced status.

Still, the basic vision remained unrealized. Consolidating voice and data functions into a single communications department doesn't make the phone and the computer work together any better--no matter what economic and administrative benefits may have been realized. As Michael Schumer of the Gartner Group, a leading systems consulting firm, said in 1988, "One of the reasons that integration, as it had been tried before, failed was that there was no focus on applications."

TRUE FUNCTIONAL INTEGRATION: THE SYNERGY OF VOICE AND DATA

The telephone and the computer are both information-processing technologies that do certain specialized tasks extremely well. When we talk about integrated voice and data, we mean using their respective capabilities in a coordinated way to meet the demands of a single task--the functional integration of the telephone and the computer.

True integration will allow the computer and the telephone switch to exchange information between themselves, efficiently coordinating the telephone answering and calling functions with relevant portions of a computer database. The intelligence of the computing infrastructure is combined with that of the telecommunications infrastructure and put at the service of any user, and any phone or terminal, in an organization's voice and data network. When functions are integrated, a single action can create two transactions, for example the simultaneous transfer of voice and data, thereby reducing effort and increasing efficiency.

The Computer Integrated Telephony (CIT) platform offered by Digital Equipment Corporation brings advanced integration of voice and data functions to users of the company's VAX computer systems. CIT software running on the VAX computer establishes logical channels to a supported telephone switching system so that an application running on the computer can request, incorporate, and monitor telephony services supplied by the switch.

In applications developed with CIT technology, the computer can automatically perform many tasks now usually done manually at the telephone: initiating and terminating calls, for instance, or answering and transferring calls, or establishing conference calls. The computer may be used to hold and retrieve calls, picking up, swapping, suspending, or retrieving calls as required. And it can receive information about the caller passed on by such services as ANI (Automatic Number Indication) and CLID (Calling Line Identification). When information from the computer's database is required in the course of phone connection, that information can be made available to the user instantly.

REAL APPLICATIONS, MEASURABLE BENEFITS

In a practical sense, what do these capabilities mean to a business using telephones and computers? Quite simply, CIT can deliver a whole new level of function for both these systems when they are used together as a single tool. With the introduction of truly effective, integrated business applications, CIT can provide an increase in the productivity of everyone who sits at a desk with a telephone and a computer screen. Because human resources are the most costly ongoing item in any company's balance sheet, these productivity gains have the potential of dwarfing the one-time economies resulting from the consolidation of equipment or departments.

While the potential of integrated voice and data applications reaches into every department and business function, a number of CIT applications have already been developed in the areas of messaging, customer service, and telemarketing. These capabilities can be applied, with little or no modification, to the needs of almost every type of business, from banking and insurance to education and health care to traditional manufacturing and corporate environments.

A NEW LEVEL OF SERVICE

Take, for example, the area of customer service. One of the first applications developed for CIT was a field service support application--meeting the customer need for rapid dispatch of properly equipped maintenance personnel in the event of a loss of service. This application combines telephone inquiries, both from the customer and field service engineers, with a database of customer histories and available resources.

In this system, the incoming call number is passed directly from the switch to the computer with calling party identification provided by such services as ANI/CLID, allowing all current customer information to be extracted and the appropriate forms presented to the service dispatcher's terminal, at the instant the phone rings. Then the computer can select the information needed to service this call and transfer the data, together with the phone call, to the specialist handling the project.

The system can even be programmed to give the specialist time to read the backup data before his phone rings. Then he won't have to ask the customer unnecessary questions when he answers the call. When the specialist enters the service requirement details on his terminal, this data is transferred immediately to the appropriate field engineer's file. Because this data can be checked by the engineer 24 hours a day, he always knows where to go next.

While this system is designed for field service departments, the capabilities used --automatic call identification, automatic database checking and display, transfer of calls and data to a predetermined chain of appropriate personnel--are clearly applicable to a wide range of customer service and telemarketing environments. The potential of integrated voice and data systems is limited only by the imagination of the user.

Instantaneous access to both phone inquiries and databases can make any call-in transaction quicker, more productive, and a more efficient service for the customer. Using CIT, for instance, it's possible to have a credit customer's record appear on a credit manager's terminal the instant the phone rings with an inquiry about credit availability--thus speeding by a matter of seconds or even minutes a transaction that occurs hundreds or thousands of times a day in some organizations.

Customer satisfaction is improved, along with the credit manager's productivity, and the ultimate benefit is to the corporate bottom line.

AT LAST, INTELLIGENT TELEMARKETING

CIT is as adept at handling outbound calls as it is in dealing with inbound calls. Therefore, it id ideal for a wide range of telemarketing, fund-raising, collections, and sales support applications. One of the foremost worldwide suppliers of telemarketing software has incorporated CIT into its applications to improve the productivity of calling representatives. Techniques such as autodialing and anticipatory or predictive dialing allow more calls to be made in a shorter time, and the monitoring functions of CIT permit managers to keep close control of call progress.

CIT also permits the merging of prospect information in the database with the placement of phone calls, to provide comprehensive list coverage and continuous update of records. For example, while a stockbroker makes a regular phone call to a client from his client list, an application can simultaneously access client account information on a VAX database and display it automatically on the broker's terminal. Should the client wish to place an order, the broker can enter the information and automatically send the confirmation to the client in either electronic or hardcopy form. The call and transaction are also automatically recorded for the broker.

The use of integrated voice and data beyond the areas of marketing and customer service has only recently begun to develop, but already exciting applications not even imagined a few years ago have become available. Emergency management applications, for instance, enable security personnel to pinpoint and respond to crisis situations faster than ever before. If a guard identifies an emergency situation, for example an intrusion or a fire, he can call the central security office from any extension. A map displayed on the security manager's desktop terminal will instantly pinpoint the guard's location, allowing support to be sent to the area immediately.

Using a public network service such as CLID, this same capability could be made available to civil emergency services such as police and fire departments. When one realizes that it can take a 911 operator several minutes just to calm a distraught caller down to the point of being able to supply a reliable location, the potential benefits of such a system in lives and property saved become obvious.

Any corporate environment can benefit from the use of CIT in message handling and scheduling. Telephone calls can automatically generate electronic mail messages, which can then be answered either electronically or by phone. The VAX database can be used to keep realtime scheduling information for executives, which can be instantly consulted by secretaries to arrange meetings without schedule conflicts. An employee can even be located electronically so calls can be routed to the proper telephone.

NO LIMIT ON NEW TECHNOLOGIES

While many of these applications have been developed for PBX environments, they are designed to be portable, with appropriate hardware, to central switch environments, which can then provide enhanced services to subscribers. In the future, new technologies will become part of integrated voice and data platforms. Already, some applications incorporate voice synthesis, one of the technologies provided by Digital's DECvoice software, to provide audio status reports of transactions that may be occurring while a user is talking on the phone or checking information on his terminal. Other DECvoice functions available to CIT applications include voice response, voice messages, and tone recognition.

What if the person on the receiving end of a call is in the middle of another task and doesn't wish to interrupt work in progress? Systems such as Digital's industry-standard DECwindows product permit a call to be answered, the appropriate information called up in a window, and the inquiry dealt with--all without disrupting the user's primary task, which remains active on the terminal screen.

CIT applications in traditional manufacturing industries have also just begun to be exploited, but innovative managers are already developing systems that use the integration of voice and data to merge a wide range of previously unconnected business functions. For instance, if a purchasing department receives a large volume of vendor calls requesting the payment status of invoices. CIT can automatically display an invoice status screen on the buyer's terminal in response to an incoming call. Or, if production needs to be notified when an order is ready for release, the order-picking transaction can trigger a phone call from the stockroom to the appropriate production control specialist. If a material planner is awaiting the receipt of material, the receiving transaction can initiate a phone call from the receiving dock to the material planner.

Applications which can benefit from this technology appear in any environment where there is interactive use of the telephone and the terminal. Therefore, the list of potential applications is limited only by the imagination of the end user--everyone with a phone and a computer on his or her desk. In fact, while many of the original ideas for voice and data integration came from telecom or data processing managers looking for new ways to maximize their system investments, ideas percolate from the bottom up today. During one recent industry meeting, 40 percent of the inquiries to Digital's representatives concerned computer integrated telephony. This is an amazing number, and it indicates not only an awareness of integrated voice and data solutions on the part of business managers but also a growing demand for new integrated applications designed to solve specific business problems.

NO PAIN, SUBSTANTIAL GAIN

Business managers are directing these requests for new applications to both telecom managers and data processing managers, or where the functions are combined, to the Corporate Information Officer. The demand for new applications suggests a new perspective on the linking of voice and data resources for telecom, DP, and corporate information managers.

In the past, linking voice and data systems may have been viewed as an economic or organizational necessity, but it was also viewed as a threat to the independent domains of telecom and data processing.

But functional integration allows for organizational independence. While CIT can be a natural next step for organizations that have completed organizational or physical integration projects, it works equally well in other organizations in which these departments remain discrete. The user's desktop is the place productivity benefits of functional integration are seen--in increased efficiency for people and equipment already at that desk.

Useful business applications, available now in the CIT environment, make these productivity gains possible. The telecom or DP manager can offer the rest of the company what business managers in all areas want: improved productivity for their people. These tangible benefits can be realized without the need to replace current voice and data equipment.

Digital's CIT integration platform is unique because it is independent of the physical integration of voice and data--it works equally well on single-wire or multiple-wire systems. While it can support a wide variety of proprietary applications, the basic CIT platform is not limited technologically to specific switches or telephone equipment.

This means the investment in existing equipment is protected. It also means that the independence of the phone and data processing systems can be protected. Both environments can still function autonomously, but both are made more robust by the interaction.

OPEN TO THE FUTURE

The real reason that CIT will enable communications managers to deliver the most competitive new applications to their customers--the business managers of their organization--is the openness of the CIT development platform.

Digital's CIT platform consists of two products: the VAX Computer Integrated Telephony Server, and the VAX Computer Integrated Telephony Applications Interface. The CIT Server manages the link between the telephone switch and the VAX computing environment, providing a command link for transfer of request and status information on the phone calls for the user's application. The CIT Applications Interface provides programmers with a rich, open development environment, consisting of a library of VMS subroutines and interface routines that enable telephone functions to be integrated into CIT-based applications, regardless of the switch being used.

An open development environment is emerging as a critical requirement for a successfully integrated voice and data product. No single company, no matter how large, can provide even a fraction of the applications that this rapidly growing market will require. One analyst's criterion for success is "open programming interfaces (for which) Fortune 200 companies can write their own applications and other companies can hire independent software vendors or buy independent software vendor-provided packages."

CIT's open architecture encourages free competition between software suppliers, each delivering components within their own area of expertise. Both consultants and vendors who have actually done CIT development work report that the CIT product is very rich in application capability. Michael Schumer of the Gartner Group has predicted that CIT "will develop into a standard for two reasons: it has the lead in terms of time and the numbers of vendors it's working with, and because of the importance of VAX-based applications."

Some of the telecommunications equipment manufacturers who have already delivered CIT-based links include Northern Telecom, British Telecom, Siemens, and Mitel. And this is just the beginning. Additional CIT development activity is ongoing and growing rapidly.

To promote open standards further, Digital actively participates in standards forums in both the areas of telecommunications and information systems networks. CIT provides developers and users with an architecture that will extend to Integrated Services Digital Networks (ISDN) applications; in fact, CIT represents an implementation of the service layer of the ISDN architecture, recognized as a more difficult and significant accomplishment than implementation of the physical layer. The programming call functions of CIT will reduce the complexity of designing an ISDN application.

CIT is also fully compatible with Digital's enterprise-wide information networks created to the OSI standard. The CIT architecture has been carefully crafted to map into the open systems environment represented by the OSI seven-layer model. Operating at the seventh or applications layer, CIT supports the physical, link, and network layers of both OSI and ISDN. Digital's commitment to the further development of international standards is evident in the company's participation in the standards development activity of the European Computer Manufacturers Association. Digital chairs the ECMA's TG-11 (under TG-32) committee, charged with developing standards for Computer Supported Telephony Applications (CSTA).

CIT applications can incorporate the many and varied ISDN services as they become available, offering a means for the public utility provider to deliver those services in a functional way to the business subscriber, further promoting their use. In addition, the CIT applications interface provides programming call functions that reduce the complexity of designing ISDN applications for the software programmer and end user.

CIT: THE START OF THE SOLUTION

Digital's CIT integration platform represents an initial and very important realization of the goal of true integrated voice and data, offering the synergy of two powerful technologies to produce real business benefits in a wide variety of situations. By delivering cost-effective, transparent applications solutions to the desktop, CIT permits business and communications managers to work together with their telecommunications vendor to develop customized solutions for their particular business problems, utilizing the telephone and computing equipment they already own.

CIT is the solution that best meets users' needs for flexibility and applications performance; application developers' needs for a rich, open environment; and communications managers' needs to deliver new and more effective solutions without risking their present technology investment.

# # #

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ISDN with Simultaneous Distribution Function and its Applications

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1. ABSTRACT

Digital circuit exchanges have the potential to reduce information distribution costs if they provide a multi-connection function, i.e. a simultaneous distribution function. This paper discusses the service forms of a network with this function, its various applications, technological issues, and its impact on information society.

2. INTRODUCTION

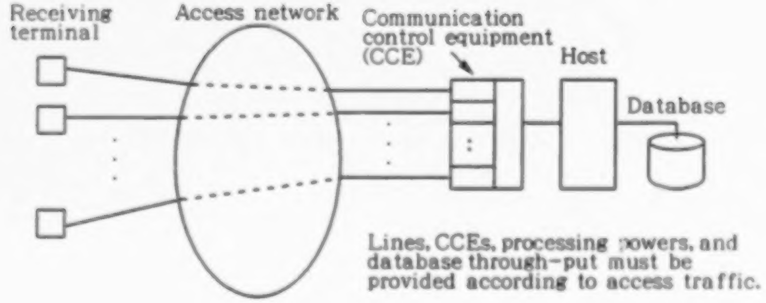
NTT began commercial ISDN service in April 1988. The service is called ***INS NET64*** and it is restricted to basic rate interface subscribers. Another service, called ***INS NET1500*** , for primary rate interface subscribers, was started in June 1989. As ISDN expands across Japan, various communications and information services are expected to appear (Table 1). The high transmission capacity and other useful features of ISDN will lead to the development of advanced information-providing services, information distributing services for handling multi-media information, and their applications.

In the area of information-providing services, there are not less needs of delivering the same information to many recipients. Existing multi-address delivery service centers must increase their communication lines, equipment, and processing power to increase the number of simultaneous recipients they serve (Figure 1). This increases the center's costs. Moreover, it is difficult to deliver the same information to many recipients simultaneously by ordinary means.

Table 1. ISDN application example

Type	Application	Utilizing features of ISDN			
		TC	MC	MS	CF
Communications	Video-phone	●	●		●
	Audio visual tele-conference	●	●		●
	High speed facsilile (G4)	●			
	Picture transmission	●			
	File transfer	●			
	Distributed transaction processing	●	●		●
	Tele-marketing support	●	●	●	●
	Remote game	●	●	●	●
	Remote telescope	●	●	●	●
	Tele-learning	●	●	●	●
Information	High resolution videotex	●			
	Multi-media database	●	●		●
	Hi-fi audiotex	●	●		●
	Audio-graphics databese	●	●		●
	MIDI coded music database	●			
	Computer software database	●			
	CAD/CAM database	●	●	●	●

TC: High transmission capacity
MC: Multiplexed channels
MS: Multiple services
CF: Control facility through D-channel


Receiving terminal
Access network
Communication control equipment (CCE)
Host
Database

Lines, CCEs, processing powers, and database through-put must be provided according to access traffic.

Figure 1. Existing information providing system

3. ISDN DISTRIBUTION FUNCTION

These problems will be resolved by introducing the multi-connection function into digital exchanges, as follows (Figure 2).

An ISDN digital exchange for circuit-switching service generally consists of memory switches. If time slot data written into such a memory switch from an input channel is read by several output channels, then the information from the input channel is distributed to these several output channels almost simultaneously within the time division multiplex switching period. The information-providing center sends an information stream to the input channel of exchange. Receiving terminals are connected to output channels of exchange, and pick up only the necessary information from the information stream.

This multi-connection function has not yet been provided in the present ISDN services in Japan. However, it would make possible various economical, simultaneous information-distribution services if it were provided.

4. NETWORK SERVICE FORMS AND VARIOUS APPLICATIONS

There can be two service forms for the multi-connection functions provided by ISDN: Mass Calling Service and Off Talk Service (Figure 3). The differences between them are in how the multi-connection is made related to call control.

4.1. Mass Calling Service

The connection between a receiving terminal and the information center is made by a call origination caused by the receiving terminal as an ordinary point-to-point connection call. The difference from an ordinary call is that the connection is allowed even though the channel from the information center is already connected to other calling terminals. Therefore, the network cost for this type of connection will be the same as, or less than, the ordinary one.

Using D-channel signals, the information center can check the calling subscriber ID. After that it connects and offers information only to members registered in the center. Also, the center can charge recipients for their information access.

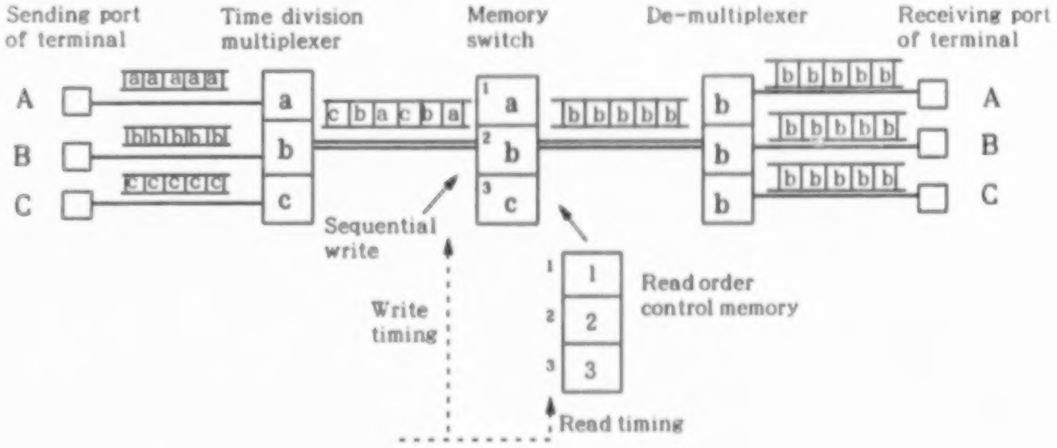
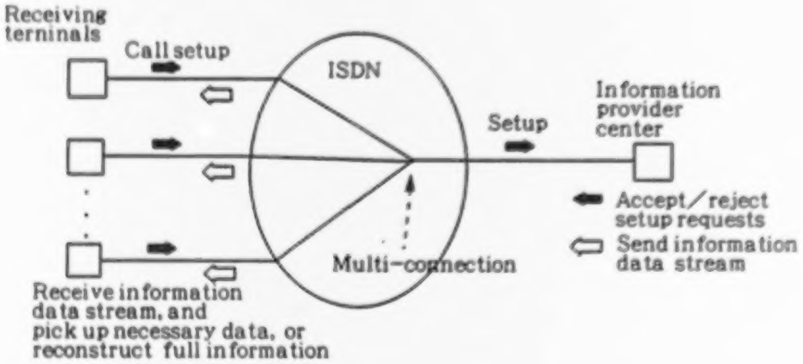

Sending port of terminal
Time division multiplexer
Memory switch
De-multiplexer
Receiving port of terminal
A
B
C
a a a a a
b b b b b
c c c c c
a
b
c
c b a c b a
1 a
2 b
3 c
b b b b b
b
b
b
b b b b b
b b b b b
b b b b b
A
B
C
Sequential write
Write timing
1 1
2 2
3 3
Read order control memory
Read timing

Figure 2. Multi-connection principal of digital circuit exchange

Mass Calling sevice concept


Receiving terminals
Call setup
ISDN
Information provider center
Setup
Accept／reject setup requests
Send information data stream
Multi−connection
Receive information data stream, and pick up necessary data, or reconstruct full information

Digital Off Talk service concept

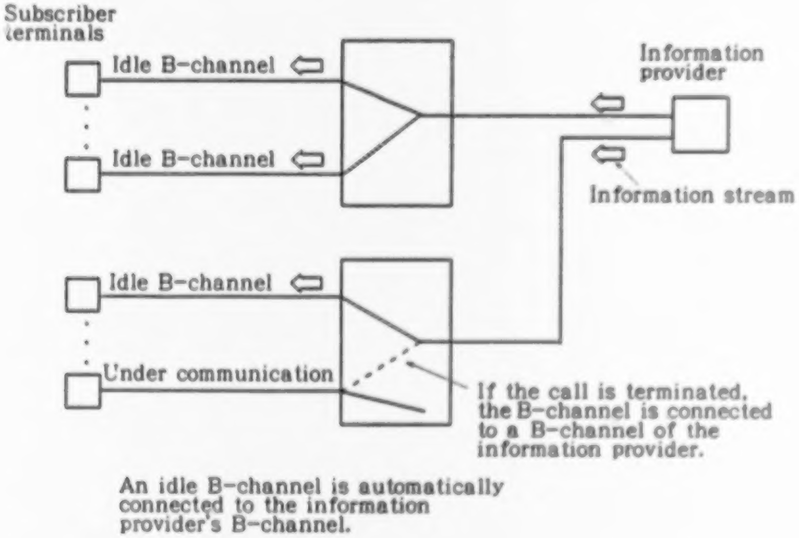

Subscriber terminals
Idle B−channel
Idle B−channel
Information provider
Information stream
Idle B−channel
Under communication
If the call is terminated, the B−channel is connected to a B−channel of the information provider.
An idle B−channel is automatically connected to the information provider's B−channel.

Figure 3. Service forms of multi−connection

There are two typical categories of applications as follows.

4.1.1. Data distribution

Typical applications of Mass Calling Service are distributing news, market information such as stocks, exchange rates, and trade. In these types of applications, many items are sent periodically at relatively short intervals. The size of each item is also relatively small. For example, about 400 news headlines per 10 seconds, each consisting of an average of 200 characters of text, can be sent at a speed of 64kb/s.

A receiving terminal picks up the data designated by the terminal user from the receiving data stream, and processes it for user. For example it displays it, or stores it in the local database of the terminal.

Information directories or indexes for these data items can be also transmitted in the form of data stream using Mass Calling Service. This ability to download information directories to terminals economically makes these types of applications flexible, i.e. category of data items can be changed easily. Using the downloaded information directories, a user can designate some item to be received.

4.1.2. Program distribution

Other typical applications of Mass Calling Service include the distribution of software e.g., personal computer software, digitally recorded music, digitally encoded pictures, electronic magazines, databases, and audio graphics, i.e, multi-media information consisting of voice and picture/video. In these types of applications, information is sent periodically at relatively long intervals, or sent once as a broadcast program at a previously specified time. Similarly, real time relay of voice and picture/video on location (such as for sports, concerts, meetings, etc.) to many receivers is possible with Mass Calling Service.

4.2. Off Talk Service

NTT started ***Off Talk Service*** using analog telephone subscriber lines in August 1988. This service makes it possible to broadcast music programs or information using voice, facsimile, or videotex, when the subscriber's line is not being used for normal communications, such as telephone. In this analog Off Talk Service, extra equipment is required in the exchange office to switch the subscriber line to dedicated lines coming from the Off Talk information sending center(Figure 4). The tariff for the analog Off Talk Service is a fixed monthly charge.

In ISDN, however, Off Talk Service can be implemented using the multi-connection function of a digital subscriber line exchange without any extra equipment. An idle B-channel is automatically connected to the information source channel if the subscriber is registered to Off Talk Service. The terminal can change the information source channel using a D-channel signal. The tariff for digital Off Talk Service could be a fixed monthly charge corresponding to the cost if the digital exchange has a non-blocking feature.

Applications for digital Off Talk Service can be same as for Mass Calling Service. In particular, applications with a long holding time feature, [illegible] program distribution type applications like back ground music, will be possible from the point of charge if digital Off Talk Service can be provided with fixed monthly tariff.

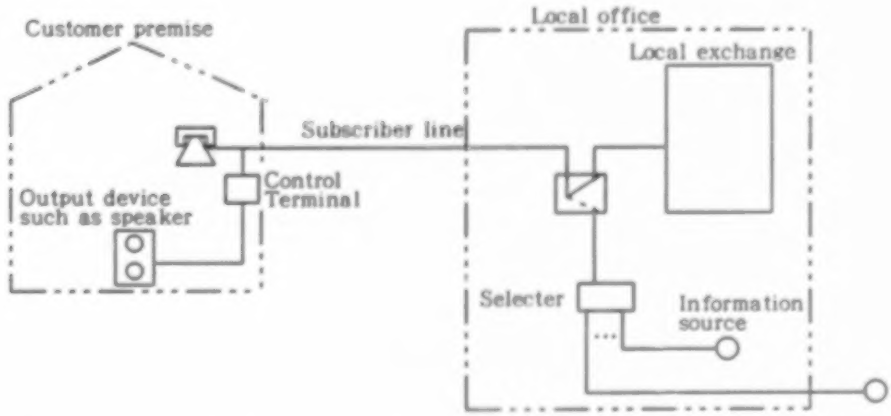


Figure 4. Analog Off-talk system

5. TECHNOLOGICAL ISSUES

5.1. Protocol

Protocols for uni-directional transmission needs to be standardized to develop the information distribution services proposed in this paper.

For the data distribution type applications described in 4.1.1, the main issues are protocol layer structure, error correction method, transmission block length and its format including header used for searching for a data item, and presentation syntax and semantics for versatile applications(Figure 5).

The program distribution type applications described in 4.1.2, require synchronous presentation of multi-media information at the terminal. Therefore, the main issues are multi-media transfer method using multiple channel, and control information syntax and semantics for synchronous presentation of multi-media. The method of error correction for data media and control information is also important.

5.2. Terminal

The necessary functions for terminals depend on the applications and media used. However, it is necessary for those multi-media terminals to be usable for ordinary communications and versatile applications. Open extensible architecture must be considered to implement the multi-media terminals first of all. Upon this architecture versatile components depending on applications need to be attached. Each component may be revised according to technological improvement. Therefore a multi-media terminal may be constructed based on personal a computer or workstation which can handle audio-visual information.

Data distribution type applications may require some specific hardware to pick up data from data stream received

5.3. Network

Congestion problems must be considered in implementing Mass Calling Functions. If there is a possibility of a large amount of traffic accessing the information center, information distribution points, i.e. where multi-connections are made, should be located as near the call originating exchanges as possible as shown in Figure 6.

However, multi-connection only at the exchange to which the information center subscribes, is useful because many applications will not generate so a large amount of accessing traffic.

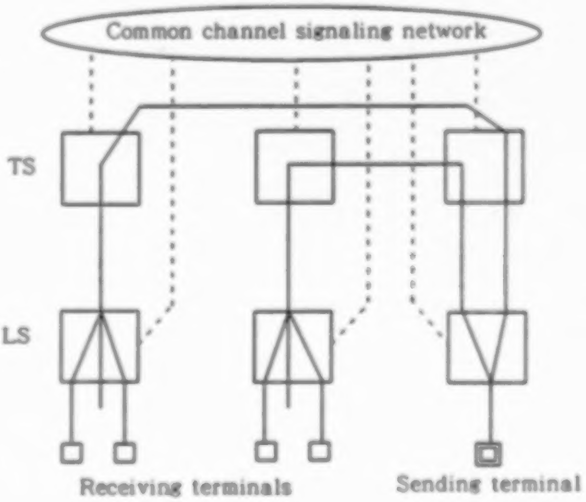

Common channel signaling network
TS
LS
Receiving terminals
Sending terminal

Figure 6. Network example for Mass Calling service

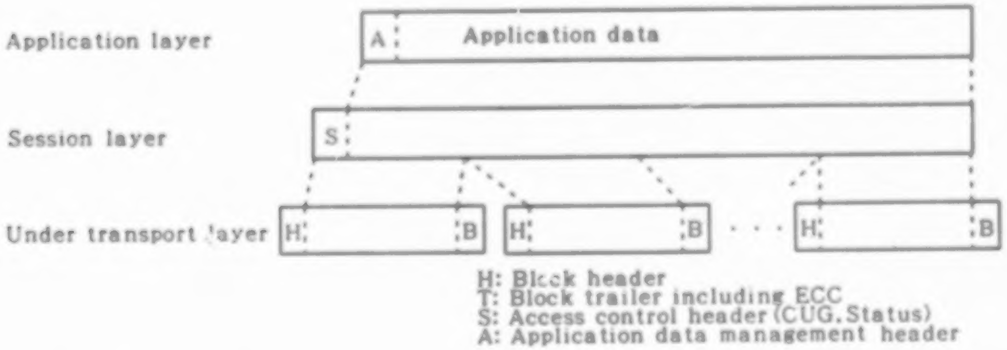

Application layer
A
Application data
Session layer
S
Under transport layer
H
B
H
B
. . .
H
B
H: Block header
T: Block trailer including ECC
S: Access control header (CUG, Status)
A: Application data management header

Figure 5. Protocol structure image for data distribution

6. IMPACT ON INFORMATION SOCIETY

Information providers can economically construct their center systems using a ISDN Mass-calling-service if small amounts of information are to be distributed to many number of subscribers. As this will have the effect of bringing costs down, various information-providing applications, which are not now suitable for broadcast because of the insufficient number of recipients and the limitation of radio wave resources, may be realized using ISDN with the simultaneous distribution function (Table 2).

Information, such as newspapers, magazines, video-clip, and music tape is not yet distributed electronically for the economical reason. However, this may occur in the near future because of the development of information equipment like the audio-visual personal computer, and the effect of decreasing information distribution costs using ISDN with simultaneous distribution function. Hypermedia such as electronic newspapers and electronic magazines, are on the way.

The increase in various information providing applications using ISDN will activate the flow of information and facilitate a prosperous information society.

7. CONCLUSION

This paper proposed to introduce the simultaneous distribution function using the multi-connection in digital circuit exchange in ISDN. It is suggested that ISDN with a simultaneous distribution function will be able to support versatile information-providing applications and will have positive effects on information society.

Table 2. Application examples of ISDN Mass Calling / Off Talk Service

Category	Application	Mass Calling	Off Talk
Business	Simultaneous message transfer	•	•
	Emergency information distribution		•
	Software delivery from maker to shops	•	
Education	CAI software delivery	•	
	Tele-lerning	•	
Entertainment	Audio-graphics	•	•
	Tele-music	•	•
	BGM, BGV		•
	Relay location (Sports, Concert, Meeting, etc)	•	•
	Supplement of broadcast (Re-delivery of past programs, Re-delivery of other area's programs	•	•

Session 5.3

Information Providers

NOTES

DATABASE SERVICE BY FENICS

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1. ABSTRACT

In 1985, Fujitsu started to provide the VAN service called FENICS with the deregulation of the telecommunication businesses in Japan. The subject of this paper is FENICS database service, and I would like to discuss our recent efforts and future tasks in terms of system architecture.

2. FENICS

Commenced in 1985, FENICS, Fujitsu ENhanced Informaton and Communication Service, became one of the largest VAN in Japan and provides a large scale network and a wide variety of services. FENICS covers all over Japan providing 7 nodes and 104 access points and has two data processing centers in Tokyo and Osaka (Figure 1). The service category of FENICS can be divided into two parts, network service and application service, and the database service which is discussed in this paper belongs to the latter (Figure 2).

3. FENICS DATABASE SERVICE

So far, the FENICS database service has been provided by five separate distributors such as Fujitsu FACOM Information Processing Corporation (FIP) and Heiwa Information Center CO.,LTD. (HIC). Fujitsu has been providing only the basic network for accessing the databases. However, such a distribution system was inconvenient for the users who access multiple database services provided by separate distributors for the following reasons.

(1) The users have to make a contract with each distributor.

(2) The users have to use different ID's and methods to access different database services.

To solve these problems, integrated database service is devised.

4. INTEGRATED DATABASE SERVICE

In May, 1988, Fujitsu announced to provide integrated database service by cooperating with FIP, HIC, and TKC Corporation (TKC), which are distributors of the FENICS database service. The benefits of this service can be discussed from a sales point of view and a systematic point of view.

4.1 MUTUAL SALES OF THE DATABASE SERVICE

From a sales point of view, the benefit which is brought by this service is the realization of mutual sales of the database service by FIP and HIC; that is, HIC can sell FIP's database service and vice versa. Contract window is unified, and the users are able to access all database services provided by both FIP and HIC by making a contract with either one of them.

Fujitsu joined this mutual sales in October, 1989.

4.2 CONSTRUCTION OF THE GATEWAY SYSTEM

From a systematic point of view, the benefit which is brought by this service is the provision of the following features by establishing a gateway system on the FENICS network.

(1) The users can access multiple database services by using the same ID.

(2) The users do not have to concern about the location of each database center because all services are shown on one menu screen.

(3) The users can access multiple database centers using the same method because of the automatic connection and logon features of the gateway system.

5. G-Search

In May, 1989, we named the FENICS integrated database service 'G-Search' and started to provide the commercial service.

5.1 SYSTEM CONFIGURATION

As of November, 1989, the G-Search system is composed of the FENICS packet switched network with 104 access points, four database centers owned by Fujitsu, FIP, and HIC, and the gateway system. It has been possible to access 850 principal database services in Europe and the U.S. by interconnecting with Telebase's gateway system in the U.S. via CompuServe's network since November, 1988 (Figure 3).

The database service which is provided by Telebase is called EasyNet. In Japan, it is called INFOCUE and is distributed by NIF, the largest PC networking service company in Japan, as a general agency.

5.2 SWITCHING OF DATABASE CENTERS

At present, the FENICS Center (database center of Fujitsu and FIP) and the HINET Center (that of HIC) control the gateway system to switch database centers from one to the other.

Described is an example of the method of the switching when an FIP user accesses INFOCUE (Figure 4).

(1) Accesses the FENICS Center via public switched telephone network, FENICS packet switched network, and the gateway system.

(2) Selects INFOCUE on the database service menu screen of the FENICS Center.

(3) FENICS Center indicates the gateway to switch the connection to INFOCUE.

(4) Gateway system connects the user to INFOCUE.

5.3 SERVICE MENU

Now G-Search provides 23 databases, and the number of the databases provided has become more than twofold compared to 10 at the beginning of the service.

The following are the databases now available in G-Search.

(1) Newspaper

① K-WINDS

Newspaper articles of The Kyodo News Service and two local papers in Kumamoto and Shizuoka, featuring cross-retrieval.

② Nihon Keizai Shinbun Articles

Newspaper articles on economy, industry, distribution and financing, provided by Nihon Keizai Shinbun.

③ Asahi Shinbun Articles

Newspaper articles of Asahi Shinbun.

④ Asahi Shinbun Evening Online Edition

News flash of Asahi Shinbun Evening Edition.

⑤ Yomiuri Shinbun Articles

Newspaper articles of Yomiuri Shinbun.

⑥ Mainichi Shinbun Articles

Newspaper articles of Mainichi Shinbun.

⑦ Mainichi Shinbun News Release

News Release to mass communication by corporation, government authority, and so on.

⑧ Chinese Commercial Flash Service

News reported on TV and radio as well as main newspaper articles in China, summarized and translated into Japanese.

⑨ Chinese Industrial and Technical Information

Main articles of Chinese Newspaper on industry and technology, translated into Japanese.

(2) Business Information

① COSMOS 1

Financial information of 130,000 leading corporations in Japan.

② COSMOS 2

Latest corporate information of 850,000 corporations in Japan including basic data, business results data, and personal history of representatives.

③ JETRO ACE

Database on economy and trade by country, provided by JETRO (Japan External Trade Organization).

④ Market Research

Database on the location of the marketing information of all industries in Japan.

⑤ MANAGEMENT

Database on basic knowledge of management and business.

(3) Technical Information

① Title Search

Database on the title of the papers appeared in the technical magazines (about 1,000 kinds).

② Techno-Search

Articles on new products, investigation and development of new technology, and trend of marketing corporations.

③ Medicine Infomation

Database on instructions attached to about 16,000 medicines.

④ Atomic Code Abstract

Atomic code abstract.

(4) General Information

① MAGAZINE

Database on corporation, industrial trend, and mass communication from various magazines.

② AERA Article

Articles published in the weekly magazine 'AERA', issued by Asahi Shinbun Sha.

③ WHO

Database on people who wrote or were written in newspapers, magazines and books.

④ BOOK

Database on publications such as title, author, contents and summary, publisher, year of publication, and price.

(5) Overseas Database

INFOCUE

6. RESULTS

At the beginning, the growth of users was slow. However, it has been increasing steadily since we enhanced the service menu, revised the billing system, speeded up database connection, and practiced active advertisement. Moreover, in May, 1989, it became possible to access G-Search from NIFTY-Serve, a PC networking service provided by NIF, and the number of the users is increasing remarkably since then (Figure 5).

The G-Search is evaluated highly in Japan, and the Ministry of Posts and Telecommunications chose the G-Search as a subject for their research on the integrated system for accessing multiple databases.

7. FUTURE TASKS

The Japanese database industry market was worth ¥43.2 billion in 1989. It is growing by 140% per annum, and is expected to grow to ¥3 trillion by the year 2000. However, to make this into reality, provision of better man-machine interface is thought to be indispensable.

From a systematic point of view, the problem in G-Search which is pointed out most by the users is the difference in retrieval method for separate database services. To solve this problem, it is necessary to unify the user interface at front-end, and realization of this feature is the most urgent task of G-Search at present.

There are many other requests for the new features such as facsimile output and clipping. These requests can be considered as indications of eager expectation of the users to G-Search.

Lastly, I hope that the G-Search will contribute to the development of the database business in Japan.

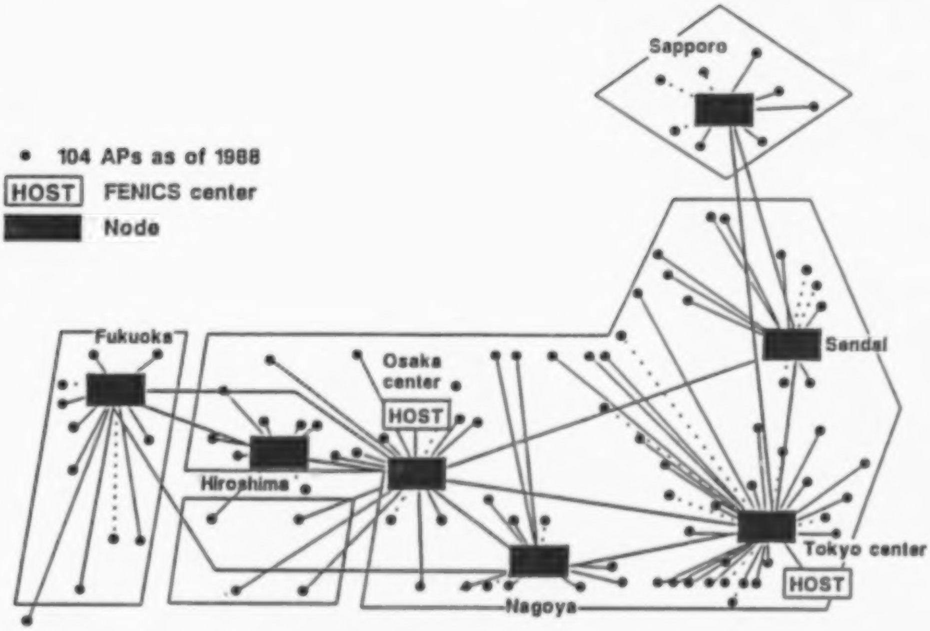


Figure 1 FENICS Network Configuration

<table>
<tr><td rowspan="4">Application Services</td><td>Business Application Service</td><td>General-Purpose Application Service (RCS/TSS)</td><td>Data Base Service</td><td>Personal Computer Networking Service</td></tr>
<tr><td rowspan="3">● Industry-Specific VAN
• Food Industry VAN
• VARNET etc.
● Inter-Industry VAN
● Intra-Company VAN
● Customized Application
• EOS (Electronic Ordering System)
• Storefront Information Gathering
• POS Data Gathering and Analysis</td><td>● ATLAS (Automatic Translation System)
● CAD
● Software Development Support Service
● User Application Processing</td><td>● Public DB Service
● CUG DB Service</td><td rowspan="3">● Mail
● Bulletin Board Service (BBS)
● Information Service
● Home Shopping
● Forum (SIG Service)
● CUG (Closed User Group) Service</td></tr>
<tr><td>Financial Service</td><td>Mail Service</td></tr>
<tr><td>● Firm Banking Service
● ATM/CD Switching Service</td><td>● Business Word Processor Communication Service
● AT&T Mail</td></tr>
<tr><td rowspan="4">Network Services</td><td colspan="4">Communication Processing Service</td></tr>
<tr><td colspan="4">● Store and Forward Service
• with/without Protocol Conversion
● DB Gateway Service
● Real Time Protocol Conversion
● Media Conversion
• Audio Response
• Fax Output</td></tr>
<tr><td colspan="4">Basic Communication Service</td></tr>
<tr><td colspan="4">● Dedicated Line Service
● Packet Switching Service
• Domestic Service (Access through PSTN and Dedicated Line)
• International Access</td></tr>
</table>

Figure 2 FENICS Service Menu

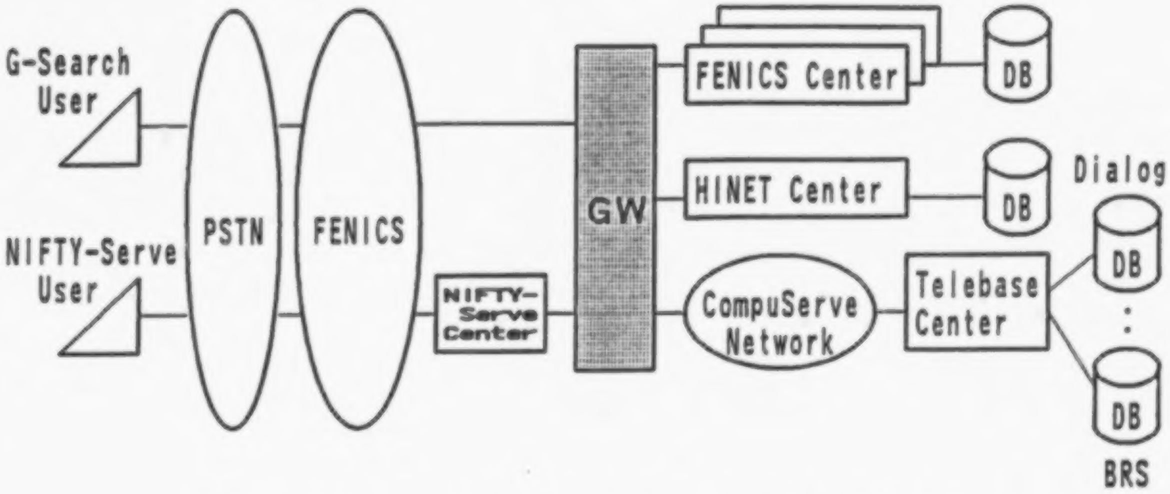
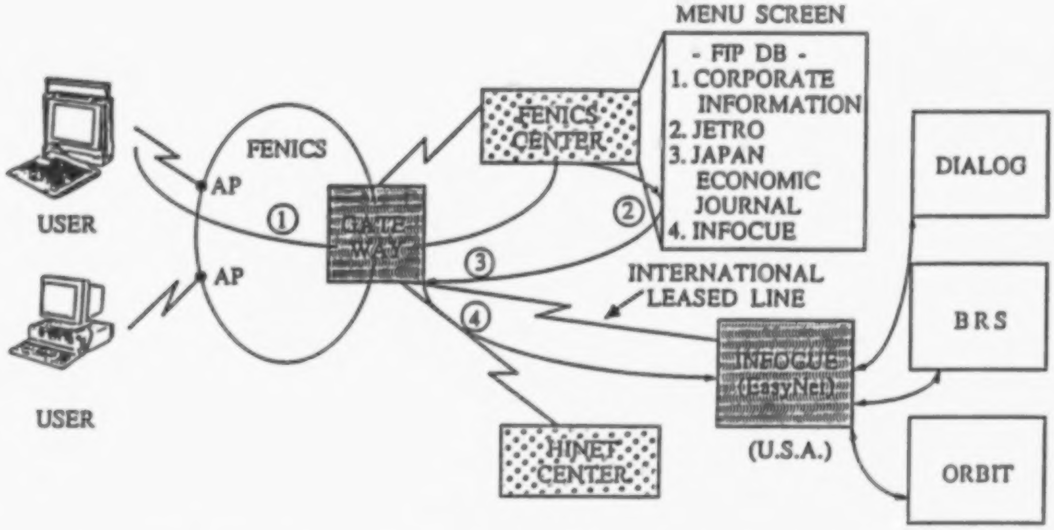

G-Search User
NIFTY-Serve User
PSTN
FENICS
NIFTY-Serve Center
GW
FENICS Center
DB
HINET Center
DB
Dialog
CompuServe Network
Telebase Center
DB
:
DB
BRS

Figure 3 G-Search System Configuration


MENU SCREEN
- FIP DB -
1. CORPORATE INFORMATION
2. JETRO
3. JAPAN ECONOMIC JOURNAL
4. INFOCUE
USER
USER
FENICS
AP
AP
①
②
③
④
FENICS CENTER
GATE WAY
INTERNATIONAL LEASED LINE
INFOCUE (EasyNet)
(U.S.A.)
HINET CENTER
DIALOG
BRS
ORBIT

EXAMPLE: WHEN A USER OF FIP DB WANTS TO ACCESS TO INFOCUE:

① ACCESSES TO THE FENICS NETWORK
② SELECTS INFOCUE ON THE MENU SCREEN OF THE FIP DB SERVICE
③ DB GATEWAY AUTOMATICALLY SWITCHES THE CONNECTION TO INFOCUE
④ CONNECTED TO INFOCUE

Figure 4 FENICS Integrated Database Service - G-Search -

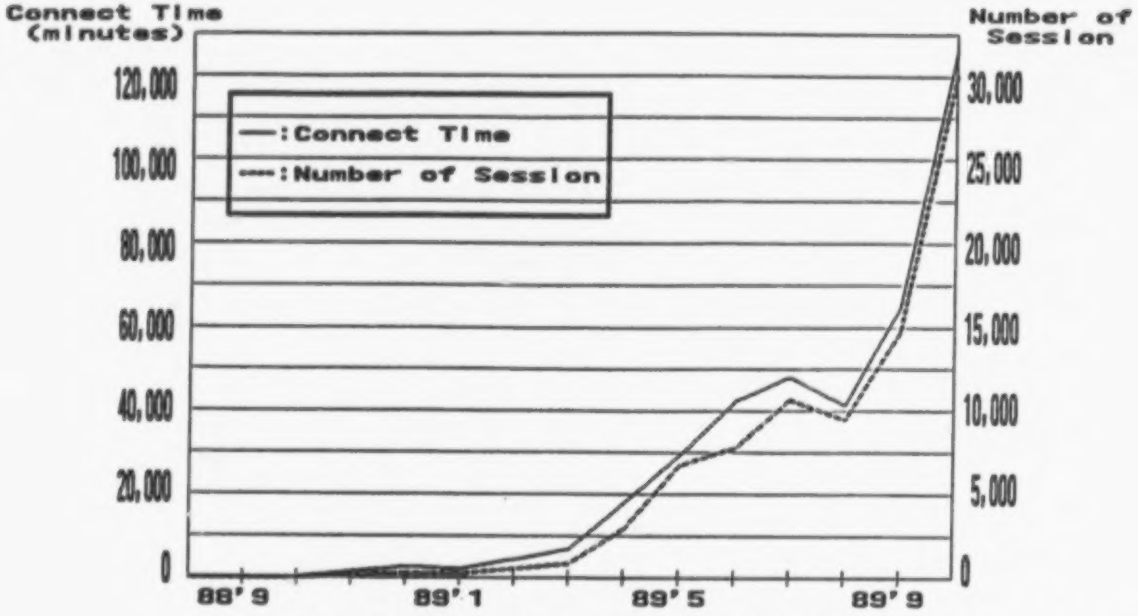


Figure 5 Growth of G-Search

COMPUTER NETWORKS FOR INFORMATION RETRIEVAL

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University of Hawaii at Manoa

Abstract

A detailed report of the Multiplatter LAN system used for searching CD ROM databases set up at the University of Hawaii during Summer 1989 is presented. The advantages of using such a system for information retrieval are discussed. A brief mention is made of its global impact as well as its future potential for information access in the developing parts of the world.

1. Introduction:

The present decade of the century has seen unbelievable advances in almost all frontier fields of research; but it is the field of library & information sciences that has almost transformed itself by making use of the highly advanced computer & communication technologies; this is mainly because of the enormous application potential of computers for information storage and retrieval. In particular, the advent and use of the **CD ROMs** (Compact Disc Read Only Memory) as high density storage devices in the last few years, have come as a boon and a booster to the field of information. The scope for application of this technology has been increasing day by day. The directory updates of CD ROM databases being published regularly in the "Online" journal is a good pointer to the rate of proliferation of this exciting and efficient form of information storage and retrieval. In fact, there are three CD ROM directories already published as books.

2.1 The Connection: "Computer, Networks, Information":

Not too long ago, the terms "Computers", "Information retrieval", "Networks", etc. were mostly used independently by professionals in different disciplines. But today, these words are rarely used in isolation- it is now "Computer Networks", "Networks for information retrieval", etc. What has brought about the "connection", is the acronym, "LAN", which stands for "Local Area Networks". The proliferation of LANs in corporations and academic environments alike in the last few years is a proof of the efficiency of Local Area Networks and their usefulness in solving many problems in the simultaneous use of computers by many people.

2.2 Local Area Networks:

Though the topic of LANs in general, is a fascinating one, it is too wide to be dealt with in this paper. Suffice it to say that there are many types of LANs, and there are many ways of looking at LANs. Two major ones (Hume, 1988), however, are: (i) LANs connecting terminals with mainframes; and (ii) LANs connecting PCs with one another. The LAN which is being discussed in this paper, however, is a special category of the second type, in the sense it uses a special form of storage media, while networking PCs into a LAN.

2.3 The Media:

The special form of storage media is the CD ROM - Compact Disc Read Only Memory. A CD ROM disc is about 4.75" in diameter, weighing only one-third of a pound. It can hold between 550 to 600 MB of information, which is equivalent to 250,000 -300,000 pages. Information is stored on the disc in digital format using optical (laser) technolgy. Manufacturing techniques for CDs is fairly standardized, thanks to the cooperation of Philips and Sony (Colvin, 1986; Hunting, 1986; Laub, 1986). A good idea of the comparative performance of three commonly used storage media (Floppy disks, Hard disks and CD ROMs) in libraries, could be had by looking at Appendix 1.

There were some initial concerns regarding the "slow" access time for the CD ROM discs, but later on, use of faster machines (with 80286/80386 chips) on LANs has brought it down to an acceptable level in most circumstances.

CD ROM discs also possess some special qualities such as resistance to heat and rough handling, as well as magnetic fields. They are also expected to have long shelf-life - around 10 years. But what had made them find lucrative markets in university libraries, is the ability to retrieve and provide the huge amounts of information on these small discs to a large number of patrons, very quickly, and at a lesser cost.(Meridian Data, 1988) than by using "Online" databases.

3.1 Literature Review: CD ROM for Information Services in Libraries

In the past several years, literature in the field of library & information sciences was flooded with articles on information retrieval using online databases. One of the primary concerns of librarians expressed in some of those articles (Carney, 1986; Williams, 1986) has been the issue of charging for the online services, which were high , because the cost involved not only the "connect time" to the database vendors' computer, but also the exhorbitent telecommunications cost. CD ROM indeed came as a "savior" to libraries. These databases on fairly "easy-to-use" discs, served almost as substitutes for the large databases held in huge mainframe computers in a far-away vendor site. Instead of having the cost, offline print delays and other factors involved in online database services, users or organizations, could lease databases on CD ROM on a monthly or quarterly flat-fee basis. This allowed besides other things, for more extensive use. expecially by novices, of the databases, since the largest component of the "online costs" were absent. The long term cost-effectiveness of CD ROM vs. online searching has been summed up rather succintly by Martin Hensel, Vice-President of Wilson-Cambridge:

"The resulting savings are significant. Even if there is no other justificaion for buying a microcomputer and a player, they pay for themselves with three hours of activity per week, when alternative is online connect charges (excluding royalties)", as quoted by Herther (1986).

The cost of CD ROM databases as well as the CD Players have fallen dramatically since the time Hensel made the statement. . Therfore, now practically every other library has gone in for CD-based information services, in whatever their fields of interest be.

According to Machovec (1989), Managing Editor of Online Libraries and Microcomputers, "…high density of storage, low cost of production (although the cost to the subscriber is often not low due to royalties to the database producer and for the search software), and the ability to run on low cost microcomputers have made CD-ROMs an ideal media for many libraries. The fact that a library can lease or purchase, for a relatively low price, unlimited access to a database for a flat fee is what librarians have always wanted. These types of products can be budgeted without necessarily having to charge back to the patron the costs of connect time and hit charges."

CD ROMs are not only used in college and public libraries, but also in large companies around the world to manage the flow of large amounts of information within their company and with their customers. "Everything from parts manuals, to product specifications, to financial records are being placed on CD ROM for access and analysis. CD ROM is becoming a standard part of the way information is consolidated, distributed, and accessed in the business world today." This is obvious when we look at Appendix 2 - Cost per Megabyte (Meridian Data, 1988).

4.1 Networking with CD ROMs:

CD ROM databases were introduced in 1986 to be used on individual workstations or microcomputers, with separate players attached to them. Only thing was that the microcomputers needed to have a sufficient memory to transfer the information from the CD to search on. However, very soon, one could choose to use internal drives for loading the CD ROM Disc instead of using separate players, making the whole unit more compact. But, the main concern of some librarians, particularly the managers, was the cost justification, when only one person could use the disc with such large volumes of data at any moment in time. This was because the database producers and vendors had only produced "single-user, single-site" CDs. As market research very quickly found out (Kolleger, 1986), the next logical demand of the users of CD products was for a "multi-user, multi-access" system. In less than two years, database producers have come up with answers to the problems of their clientele and we now actually have quite a few vendors who provide exactly the "multi-user, multi-access" CD ROM databases. Their products provide the use of large databases on CDs to be searched in a Local Area Network environment, i.e. they come with multi-user licensing.

4.2 The Pioneers:

Since the introduction of such multi-user CD ROM databases by one of the vendors, i.e., SilverPlatter, six universities have intalled LANs in their libraries, BOSTON UNiversity being the forerunner (SilverPlatter Press Release; Network News, 1988) of the System, sold under the brand name "Multiplatter". University of Hawaii is the sixth such campus to join the leaders in the implementation of the CD LAN using MultiPlatter System and following is a brief case study of the same.

5.1 Case Study Project:

The CD LAN was set up at the Sinclair Library, University of Hawaii at Manoa, during the Summer of 1989. The CD ROM Committee of the Hamilton Library (the Main Library of the University) has had extensive discussions on the choice of the system to be adopted for the LAN. The final choice had to be made between SilverPlatter's MultiPlatter product and the one offered by Meridian Data Inc., which were the two products that met the needs of the Hamilton Library best among many others. (The criteria for the choice is provided in the section on "Discussions")

5.2 Definition:

MultiPlatter is SilverPlatter's complete networking package that accesses a collection of CD ROMs through one designated system. It is a stand-alone network which links multiple workstations (IBM PCs) to multiple CD ROM databases. The MultiPlatter System is defined as the "CD ROM disc drives, server(s), expansion unit(s) and the personal computers that are also part of the MultiPlatter network". (Reference Manual for MultiPlatter System, 1989)

5.3 Setup and Constraints:

MultiPlatter offers upto 21 CD ROM drives and multiple workstations; security for CD discs and drives; simultaneous access to one CD by multiple users; "easy to use" SilverPlatter search and retrieval software; quick and easy installation procedure; one year of SilverPlatter customer telephone support, and, six months of hardware maintenance. Each MultiPlatter software package supports up to four workstations and comes with detailed documentation for installation guidance. Additional workstations can be added at any later time.

One of the most important requirements while networking with CD ROMs is to overcome the 32 megabyte file size limitation and allow DOS access to the entire 682 megabyte capacity of a CD ROM. Microsoft has introduced the MS DOS CD ROM Extensions to do just this. With this software, any PC/XT/AT/386 or full compatible can have access to the large amount of information available on CD ROMs. These are called MSCDEX and adhere to the industry standard High Sierra/ISO 9660 CD ROM file structure standard.

5.3.1 Cost:

The cost of the system is about $17,440. The costs of the individual workstations to access the CD databases are not included in the system cost. All terminals have to be IBM PCs, or, 100% compatible, with 640 KB memory, a minimum of 10MB fixed disc storage, standard monitor and keyboard. Also, the cables and connectors, which must conform to SilverPlatter specifications, had to be purchased and installed by the purchaser.

5.3.2 Physical Description:

The server is almost the same as a workstation on its side, but without a monitor and keyboard. It also houses the 5 CD drives stacked one upon the other, just above the CPU of the Server, all hardware being enclosed in the same frame, measuring about 10" x 20" x 24". It occupies very little floor space and can be stored away from the users in a secure place. This would effectively avoid disc thefts.

Each CD ROM disc is enclosed in a caddy. The caddy itself is inserted into the CD ROM drive. There is a blue EJECT button which pulls the tray with the caddy out, whenever a CD is to be loaded or changed. However, a CD disc cannot be removed from the MultiPlatter System Server without reloading the software on the Server and rebooting each of the workstations.

Again, the sequence of turning off the workstations is not a critical one. But, if the CD ROM discs need to be taken out or, changed, it is necessary to EJECT them before turning off the System Server, because the EJECT buttons do not work when the power is off.

5.4.1 Installation Procedure:

As was demonstrated by Mr. Pete Ciufetti of SilverPlatter Information Inc., who flew in to set up the MultiPlatter-based CD LAN on the 27th of June, 1989, the installation of the CD LAN was a rather simple procedure. A detailed Manual (proprietay) of about 45 pages provided by SilverPlatter explains the procedure of installing the software on the network server as well as the individual stations.

The installation required the floppy labelled "MultiPlatter Server Boot Diskette" to be inserted into the disc drive of the Server, and the power for the Server turned on after ten seconds. The software loading took about 60 seconds. Then the five CD ROM discs were loaded into the five CD drives on the System Server. As soon as the MultiPlatter System Server was booted and the CD discs were loaded, the workstations were turned on, one at a time. This was to allow loading of the SilverPlatter Network Manager Software by each workstation completely before turning on the next one. Each workstation could be used to access the MultiPlatter System, as soon as it had the Network Manager software loaded on to itself, even though the other workstations in the network were still loading the software. This shows the advantage of this LAN configuration, which is like a bus (each device is attached directly to the bus/network cable, without affecting the performance of other devices), where a problem with one workstation does not impair the performance of the whole network.

5.4.2 Facilities:

One of the important procedures to be followed in getting the workstations ready for use, is the MultiPlatter Menu Editor Facility. This procedure is described in detail in the manual, in three major sections, i.e. "Starting MENUEDIT", 'Creating a Menu with MENUEDIT", "Modifying a Menu with MENUEDIT". (The only difference between the second and the third sections is in the Command Functions on the respective screens).

"MENUEDIT" is a facility that builds and/or modifies the menu which the LAN users see on the workstations. "MPMENU' is the facility which actually presents this menu to the users.

5.4.2.1 MENUEDIT:

MENUEDIT identifies all the parameters required by MPMENU to successfully distinguish each CD ROM available on the LAN and start the correct application software needed to run a selected database. These parameters include, 'Menu text for each selection', 'DOS commands for starting each application', 'Password for entering the application' (optional), 'Action to be taken by the System, if a database is offline', 'Label text and summary groups for statistics reports' and 'Maximum simultaneous users allowed to use each application'. There is an other set of parameters which affects the way the menu is presented, and this includes: 'An installation name which appears at the top of the menu', 'An option for a "screen save" and 'An option for numbering the menu items'. A noteworthy feature is that the menu of available applications need not be restricted to CD ROM applications. Almost any application that one wishes to make available at the workstations could be included on this menu choice.

5.4.2.2 MPMENU

As mentioned earlier, MPMENU is the facility that displays the menu created by MENUEDIT. This helps users to smoothly switch from one apllication to another and it is the first screen presented to the users. MPMENU can start any DOS application including non-CD-ROM applications. This is achieved by building a DOS batch file for each application and then transferring control to that batch file. The instructions for doing so are however identified to MPMENU by MENUEDIT when an application is first made available on a MultiPlatter System. (These are the same commands that a user needs to type to start the applications from the DOS prompt.) MPMENU relieves the users from having to type all these instructions and helps them to choose the application directly from the menu.

MPMENU has another important function to perform, which is of great interest from the Librarian's point of view. This is the function of collecting and archiving usage statistics. As each item is selected from the menu, MPMENU first checks to make sure that the application is available; if yes, it records the time of selection and starts the application for the user. When the user exits the selected application and the control is returned to MPMENU, it calculates the elapsed time since the application was selected and stores the statistics on the hard disk.

6 Discussion:

Any modern library, particularly one which caters to a large community of university students, faculty and staff, has to keep up with the latest developments in technology for improving its services to its patrons. Hamilton Library had been operating stand-alone CD workstations in its three Reference Departments (Sci.Tech., Humanities & Social Sciences, Government Documents) for about a year. Hamilton Library rightly decided that it was time to install a CD-based LAN to serve its patrons better, because the one hardware configuration which would provide the largest number of patrons the greatest access to the maximum number of reference works is a LAN, based on multiple-CDs.

The choice of the SilverPlatter's MultiPlatter product was based on the fact that the vendor provides essential services in addition to provision of hardware and installation. It also provides assistance with configuration, trouble-shooting, maintenance and telephone technical support for a full year as part of the purchase contract of the LAN hardware. The "MultiPlatter Network Manager" software which is proprietary CD Network software supplied by this vendor, is tailor-made to the needs of library clientele. SilverPlatter also has an added attraction to the Librarians - it has and continues to arrange network licensing agreements with providers of CD databases for use on their MultiPlatter network, a service which its competitor Meridian Data Inc. does not provide.

Incidentally, University of Hawaii has been invited by SilverPlatter to be a part of its "Controlled Release for MultiPlatter" during mid 1989. The other installations include Boston College, the Medical Center Library at Vanderbit University, Brandeis University (the first MultiPlatter Site to offer non-SilverPlatter products) and California State Politechnic University in Pomona. The goal of this Controlled Release Program is to work with these sites in developing system enhancements for general release of MultiPlatter later in 1989. A concessional price has been offered by SilverPlatter to UH for participating in the program.

There is a detailed MultiPlatter Customer Support Log which comes with the manual. Each Site is asked to assist in documenting any problems which they face while using the System. A toll free number is provided with the name of a person to be contacted. This is highly desirable and necessary, particularly when this is a part of the MultiPlatter Controlled Release Program.

7. Future Scenario:

It is certain that the next release of the product would be better than the test system, because it would take into account the comments and suggestions of the test sites. For instance, one of the minor problems noticed was that the online instruction for choosing the database by the serial number instead of using cursor keys, appears only on the second screen instead of the first screen presented to the user (which would be more appropriate). Again, some inadequacy has been noticed in the way the usage statistics package has been designed. These and other suggestions are likely to be taken care of in the next release, which is due by the end of the year. But it now appears most probable that many more libraries as well as organizations dependent on more than one large database for information, would go in for CD ROM based LANs in the future, particularly with increasing number of database producers providing multi-user licences and vendors coming up with more and more sophisticated LAN systems for CDs, such as common commands/menus across databases.

8 Global Impacts:

Articles have started appearing in some journals on the impact of CD ROM databases for information handling in the developing countries. Noteworthy among them is a report of an 18-month project sponsored by the International Development Research Centre, Ottawa. (Beaumont; Balson, 1988) A prototype bibliographic database on CD ROM was installed in six developing country libraries and information centers to provide hands-on experience for participants. The findings of the project predictably included the observation that CD ROM technology had a vital role to play in the information delivery process in those countries as well as the fact that not much on-site support was required after the initial set up of the system. The primary benefit of course, was that access to online information search could be had without incurring telecommunications and connect charges. Beaumont and Balson also recommend that information providers and electronic publishers work together with donor agencies and potential subscribers to understand the "new market" opportunities that developing countries offer, as well as their special needs in terms of documentation and "self-help" tools. They also call upon the potential users of CD ROM products in developing countries to "share" their resources. The "sharing" which they hoped for, is made more possible with the CD LAN systems that have made their entry into the information decade sooner than expected. If the database producers and vendors of LAN systems continue their efforts to standardize their wares (harware and software), the market for CD LANs appears to be a profitable one, not only in the West, but also in all parts of the globe.

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Session 5.4

Transborder Applications

NOTES

A Telecommunications Bridge Across the Bering Sea

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ABSTRACT

With the warming of relations with the Soviet Union, especially between Alaska and portions of the eastern Soviet Union, Alascom saw a need to provide more convenient and efficient telecommunications links with the Soviet Union. Alascom engineers, working with their Soviet counterparts, designed and installed a VHF radio system which today provides five circuits between Alaska and the Soviet Union. The ability to call into the USSR without having the call travel virtually around the globe has resulted in an increase in usage, greater clarity, and broader ties between our two regions.

We human beings have just reconnected Mother Nature's original design in the far north.

Alaska and the eastern Soviet Union (it's not called "Siberia", by the way)...Alaska and the eastern Soviet Union were once connected by land. Now, our two worlds are reconnected by telecommunications. But, I'm getting ahead of my story.

Alaska and the eastern Soviet Union share a long and fascinating history.

Alaska's Native peoples tell of a bridge of land across what is now the Bering Straits. That broad land bridge was flat and low, and dotted with many lakes, like the land of Alaska's North Slope today. Prehistoric peoples migrated over the bridge, following the animals of their food supply.

According to Native oral tradition, earthquakes and floods swallowed the land, and it sank to the ocean floor.

But the loss of their land bridge didn't separate the Native peoples. Braving summer's stormy seas in their skin boats, and winter's treacherous icepack on dogsleds, the coastal Eskimos continued to travel back and forth.

In 1742, Vitus Bering, a Dane sailing for the Russian czar, became the first white man to discover Alaska. He proclaimed it "Russian America", beginning 100 years of occupation, exploration, and exploitation of Alaska's rich fur resource. Alaska's wealth of Russian place names and the vital Russian Orthodox Church harken back to this period.

In 1867, the United States and Russia executed a giant land deal: The U.S. bought Alaska for $7,200,000--that works out to just about 2c per acre!

The Alaska-Russia geographic proximity also played an important role during World War II. Pilots ferried aircraft bound for Europe under America's Lend-Lease Program through Alaska and the Soviet Union.

But in 1948, the Cold War escalated. An "Ice Curtain" descended between the two neighbors. The U.S. and Soviet Union closed the Bering Straits border, severing the age-old ties.

Which brings us to today. The exciting events of glasnost and warming relations between East and West have opened the way once again for connection between Alaska and the Soviet Union. We at Alascom are proud to be in the forefront of that movement.

For those of you unfamiliar with our company, Alascom is the dominant long lines carrier in Alaska. We're the carrier of last resort. This means we're required by the FCC to provide long distance telecommunications service to every community in Alaska with 25 or more residents. We serve 245 communities--45 of these have fewer than a hundred residents. And almost 200 of these remote towns have no highway access. We at Alascom face no easy task!

Alascom began serving Alaskans in 1971, when its then-parent company, RCA, bought the Alaska Communications System from the Federal government. Alaska's antiquated, inadequate system had been designed primarily to meet military needs, and served just 50 locations.

Today Alascom, now owned by Pacific Telecom, serves 300 locations. Our state-of-the-art network of satellite, microwave--and soon fiber optic cable--covers a state of 586,000 square miles (that's one fifth the size of the entire continental United States), with 500,000 residents.

Alaska is the only state in the nation served by its own satellite, "Aurora", which Alascom launched in 1983. We will launch a replacement satellite, "Aurora II", in June, 1991. We serve about 200 of our locations by satellite, the only practical way considering our rugged geography, distances, and sparse population.

A microwave system, which we're upgrading to a fully-digitized network, connects Anchorage to population centers in the Interior, Southcentral, through Canada to Southeast Alaska, and on down to Washington state and the rest of the U.S.

Alascom is currently installing an under-sea fiber optic cable from Seward, Alaska (125 miles south of Anchorage) to Pacific City, Oregon, near Portland. We'll complete this cable system in December of this year. It's part of a trans-Pacific fiber optic cable system between Oregon and Japan, a project of Alascom's sister company, Pacific Telecom Cable; IDC of Japan; and Cable and Wireless of Great Britain.

Alascom has come a long way in barely 20 years--in Alaska and beyond! Not only do our technicians and engineers regularly solve telecommunications challenges in Alaska--but in remote regions around the world as well.

I'll give you several examples--two of which made global headlines: the Exxon oil spill, and Hurricane Hugo.

Within 24 hours of the grounding of the Exxon Valdez tanker in March, 1989, Alascom's own invention, the rapid-deployment transportable earth station, was providing space-age communications to the world from the wilderness of Prince William Sound.

This transportable consists of a van housing electronic equipment and a generator--we affectionately call it the "Batmobile"--and a trailer carrying a 15-foot collapsible antenna.

In September, Hurricane Hugo slammed into Puerto Rico, destroying the critical telecommunication links with the outside world. The U.S. military called on Alascom. Within a short time, our technicians and transportable earth station were aboard an Alaska National Guard C-130 Hercules aircraft for the 5,000-mile trip to the Caribbean.

You know, it's pretty incredible for someone who's used to Alaska's snow and ice and freezing temperatures--to see photographs of our technicians dressed in shorts with the palm trees waving over the Batmobile!

The third example of Alascom's problem-solving brings us back to the beginning of this presentation, to the connection between Alaska and the Soviet Union.

In January, 1988, the U.S. Information Agency invited Alascom to participate in a seminar that would travel through seven Soviet cities. The subject? The Global Telecommunications Network. With the endorsement of the State Department and Alaska's governor, Alascom officials met with high-ranking telecommunications officials from several Soviet agencies.

What we found was this: we shared many similar experiences in providing communications in the Arctic. For instance, snow accumulation on antennas. After we described our fancy cover heaters and special paint, and the Soviets too described their efforts--we shared a chuckle as we all agreed on the best technique to get the snow off: strong arms and a broom.

In April, 1988, we were asked to participate in an Alaskan conference to explore the potential for exchange programs with the Soviet Union. Gennady Gerasimov, chief spokesman for Soviet President Mikhail Gorbachev, was a key presenter at the conference. Mr. Gerasimov expressed amazement at Alaskans' interest in developing relations with the Soviets.

The conference held great promise for a thaw in the "Ice Curtain". A short aside about thawing ice. Each spring, we celebrate a contest, where Alaskans statewide bet on the exact date, hour, and minute when the ice will go out on the Tanana River. The winner reaps a jackpot worth thousands of dollars. It's a pretty exciting event. And so is the melting trend between us and the Soviets.

Also in the spring of 1988, Alaska Airlines requested authority from the U.S. and Soviet governments to make a cultural exchange flight between Nome and Provideniya. The flight would focus attention on reopening the Bering Straits border to cultural, educational, and family exchanges. On board the flight would be a delegation of Alaska Natives, political leaders, business executives, and journalists.

We contacted Alaska Airlines, and offered our telecommunications system. This spectacular event deserved global attention, and Alascom's system could give the media a live hook-up to world news networks. Alaska Airlines was delighted with our proposal, and we applied for permission to travel along.

Both Alaska Airlines' and our requests were approved, and the "Friendship Flight" was scheduled for June 13, 1988. Alascom had just seven days from receiving the go-ahead to be ready to uplink live video from the remote Soviet city.

After weeks of planning and preparation, Alascom's team sprang into action. Since our motto is "Expect the Unexpected", we took two of every single piece of vital equipment. We were sure

Provideniya would NOT have a "True Value Hardware Store" for spare parts.

The day before the Friendship Flight, eight Alascom employees plus a media crew took off from Anchorage in the company's Beechcraft King Air and a leased C-130 Hercules. The cargo plane carried a transportable 25-foot diameter antenna, a mobile electronics van, an eight-kilowatt diesel generator, and fuel. They stopped briefly in Nome, then headed for Provideniya, 225 miles into tomorrow.

This was not as simple as it sounds:

> There are no air traffic links between the U.S. and the Soviet Union.
>
> Second, there was no reliable weather data.
>
> Measurement changed from miles to kilometers at the International Date Line.
>
> And finally, we didn't speak much Russian and the Soviet air traffic controllers didn't know much English.

But despite these hurdles and poor weather conditions, we made it in safely. Our technicians were itching to get to work. But the warm, hospitable people of Provideniya insisted the entire crew sit down first for a get-acquainted meal.

The town square, 10 miles from the airport--a 45-minute drive on rough roads--was selected as the site for the earth station.

It took nine hours to assemble the antenna and orient the dish to our Aurora satellite. We discovered that the town was built over an ore lode, which affected the magnetic field. Because of this interference, orienting the dish took longer than we'd anticipated. The Soviets were fascinated by the fast-paced and precisioned approach of our crew.

At 5:00 in the morning, Anchorage time, on Monday, June 13, Lee Wareham, Alascom's vice president of operations, made the first Provideniya-Alaska telephone call. He woke up Ginna Brelsford of the Alaska Governor's Office of International Trade, who a few hours later, would be boarding the Friendship Flight to Provideniya.

As arrival time neared for the Friendship Flight, Alascom was ready. An array of telecommunications links went up to Aurora, then down to Alascom's Eagle River earth station outside Anchorage. We had:

1) a full-time video circuit to carry television reports to Anchorage stations;

2) four direct-to-toll telephones for operator-assisted and credit card calls to any point in the world;

3) six phones which allowed a caller to dial "9" and any Anchorage number; and

4) two phones wired to Alascom's Anchorage office.

We also provided a "double-hop" for video, which carried the broadcast from our Eagle River earth station back up to Aurora for transmission to the eastern U.S. and the Soviet embassy in Washington, D.C.

And what a day it turned out to be! It was exciting and emotional for people from both sides of the border. Many Alaska Natives rekindled acquaintances with Soviet relatives and friends. We'll show you some film clips in a moment so you can feel the excitement of the event.

As the Friendship Flight departed, the Alascom crew continued right on working, now dismantling everything they'd set up and run. I can tell you no one had much sleep during those adrenalin-filled three days.

Finally, it was "wheels up" for the Alascom crew. Our chief pilot, Felix Maguire, took the plane back by the control tower in a symbolic low-level fly-by. He rocked the wings in fond farewell to our Soviet hosts.

All-in-all, the Friendship Flight rated a great success. Political barriers were broken down, family ties re-established, old acquaintances rekindled, and technical capabilities demonstrated. But perhaps most importantly, that old "Ice Curtain" between Alaska and the Soviet Far East had begun to melt a little.

In September, 1988, a group of Soviets arrived in Nome via boat. Alascom, Alaska Airlines, and the Governor's Office hosted their visit to Anchorage, where they spent a day in meetings and visiting Alaskans. We honored them at a special dinner--that was the official program. But the high point of the trip for many was a late-night visit to a 24-hour supermarket, where they were overwhelmed at the abundance and selection of products.

Interest in developing commercial and cultural ties between the Soviet Union and Alaska continues to grow. And the progress continues. The three most critical factors in connecting Alaska and the Soviet Union are diplomatic relations, transportation, and telecommunications.

Our relationship with the Soviet Union took another step forward in October, 1988, when Alaska Governor Steve Cowper hosted a Trade Mission to the Soviet Far East. They went to

Magadan, the administrative center for the Provideniya region, which was still off limits to most foreigners at that time.

They wrote a "Protocol of the Business Meeting between the Magadan Region and the Alaska State Delegation". This document reflects the interest of many Alaskan business leaders in mutual trade, fisheries, mining, and tourism. It also laid the groundwork for future visits between Magadan telecommunications officials and Alascom.

In April, 1989, another agreement between Alascom and the Magadan Territorial Board of Communication was prepared. This official agreement was called the "Protocol of Collaboration". Ironically--or maybe appropriately--the agreement was signed via a long distance telephone call, rather than in person.

Governor Cowper and I had planned to attend the formal Protocol signing ceremony at the International Date Line on the Bering Sea ice. The ceremony would also honor the Soviet-American Bering Bridge Expedition of cross-country skiers. But, as often happens in the Arctic, the weather closed in, and the Governor and I were stuck in Nome. Fortunately, our crew with the transportable earth station did make it in, so we participated, via satellite, in the ceremony 120 miles away!

That April Protocol agreement created the opportunity for communication break-throughs later in the year. In September, 1989, in Gambell, an Alaska village 64 miles from Provideniya, Alascom installed an 80-foot tower with a VHF microwave antenna--perfect for line-of-sight transmission to a Soviet mountaintop site above Provideniya. And, we provided a VHF radio system for both sides.

Two years ago, only 16 long distance circuits connected Moscow and the United States. Any call between Alaska and the Soviet Union (even a call from Nome to Provideniya, only 225 miles away) was routed completely around the world the other way--from Alaska to AT&T's Pittsburgh overseas center, to Moscow, to the final destination. FAX and data transmission rarely worked.

In connection with our earth station in Gambell, we turned up five of 12 new long distance circuits between Provideniya and Alaska. One of the five new circuits is dedicated to Provideniya. The other four are routed through Provideniya to Anadyr, a community 300 miles to the west, for distribution throughout the region.

With this new microwave link, a call from Anchorage to Magadan now goes from Alascom's Eagle River earth station near Anchorage, up to our Aurora satellite, down to our earth station at Gambell, across the Bering Sea by VHF radio to Provideniya, and from there via troposcatter to Magadan. It sounds like a lot of connections, but it is incredibly faster than routing the call around the world!

We have learned we have to be creative while thawing the "Ice Curtain"; especially when it comes to financial arrangements. Because the ruble and dollar are not exchangeable currencies, trade is very complicated. For the initial phases of our agreement, we have decided on a "sender keeps all" revenue arrangement. That means if we place the call, we keep the revenue. If they place the call, they keep the money.

Other businesses are getting into barter type arrangements. For example, an Alaskan meat processor exchanges his technology and know-how for Soviet reindeer antlers, which he then markets in Asia, where antlers are highly valued for their (alleged) aphrodisiac qualities. Now, we're not ready to be quite THAT creative.

So, what lies ahead? In November, 1989, both Alaska's long distance telephone companies announced plans to tie into AT&T, thus allowing Alaskans to dial direct to the Soviet Union.

Present facilities allow only limited expansion of traffic between the Soviet Union and Alaska. The next phase of enhanced direct-ties could be either satellite or an upgrade of the Gambell-Provideniya link to a 300-channel microwave system, with a simultaneous upgrade of the Soviet network. The latter seems a better immediate choice, since no satellite is currently positioned to provide optimum service between Alaska and the Soviet Union.

However, the Soviets have reserved the 170° west slot above the equator for a future satellite. This spot is perfectly positioned to "see" not only Alaska and the Soviet Far East, but most of the Pacific Rim as well. We are very interested in the possibilities this offers and have already begun discussions with the Soviets about uses of their future satellite.

Many questions remain to be answered: Will commercial traffic grow and justify additional circuits? How will the problem of non-exchangeable currency be resolved? But in our optimistic view, problems are only solutions waiting to be implemented.

Less than two years ago, the concept of a telecommunications bridge across the Bering Sea was only an idea.

Today, Alaskan business people regularly call their counterparts in Magadan, Anadyr, Provideniya, and points west and south. Alaska Natives call relatives in the small Soviet villages of New Chaplino, Orel, Uelen, and Pevek on the Arctic Coast. Traffic volume far exceeds early expectations.

Alaska and Soviet technical teams have become not only associates with similar goals of establishing and maintaining excellent communications, but have, in many cases, become personal friends.

In our 18-year history, Alascom has faced many challenges and is credited with many "firsts". In 1971 when Alascom was formed, Alaska was a third-world country as far as communications were concerned. Alascom has put together an innovative network designed to meet the unique needs of America's largest state. We were first to bring direct dialing to Alaska; first to bring in regular television programming; and, first to give a state its own satellite. The list is long.

And Alascom's knowledge and experience has proven to be transferrable to remote and developing regions throughout the world, most recently to our neighbors across the Bering Straits.

In my opening comments, I recounted how Alaska's Native people tell of the disaster that destroyed the land-bridge across the Bering Sea. Today they're worried about a modern disaster. They are worried that as the old people die, the unique Native culture will die also...that as the story-tellers of their rich Native heritage die, fewer and fewer young people will keep alive the ancient traditions.

But there is new hope. It comes in the form of the new bridge across the Bering Straits, the bridge of telecommunications and travel. Native people in both lands express enthusiasm and excitement about their rekindled connection. Trade and commerce may well be what makes the link across the sea viable, but ultimately it is the will of the people that will melt the "Ice Curtain" to revive cultural and social ties interrupted 40 years ago.

We at Alascom are proud to play a major role in rebridging the Bering Sea.

Recent Developments in Transborder Telecommunications Services between the United States and Canada

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1. ABSTRACT

The dramatic structural and regulatory changes experienced in the United States telecommunications industry in the past decade and the more recent introduction of competition in Japan and the United Kingdom are affecting Canadian telecommunications users and service providers alike and are putting pressure on Canadian policy makers and regulators to initiate changes in Canada. Liberalization of Canadian regulatory policy towards competitive MTS/WATS service provision would also have impacts on the United States-Canada transborder services market.

2. INTRODUCTION

Historically, the United States and Canada have represented each others largest international calling point. Canada and the United States have an obvious community of interest with a shared common border of approximately 3,000 miles. Approximately 80% of the Canadian population is located within 200 miles of the border.

The geographic proximity of the two national markets, coupled with a high degree of economic integration, makes it impossible for Canada to be left unaffected by American economic policies. This is as true in the telecommunications industry as in other sectors of the economy.

Canada and the United States are each other's largest trading partners with more than 70% of all Canadian exports going to the United States and more than 20% of all American exports destined for Canadian markets. With the 1988 United States/Canada Free Trade Accord, commerce and trade between these two neighboring countries is expected to continue to rapidly expand, producing an even greater demand for state-of-the-art, competitive telecommunications services.

Currently, the United States to Canada voice telephone market generates approximately 2.4 billion minutes of traffic per year. The Canadian telecommunications service market generates annual revenue of approximately $12 billion dollars (Canadian) with total toll revenues at approximately $8 billion dollars, growing at a rate of nearly 9% per year. Comparatively, the United States toll market is estimated at over $60 billion dollars (U.S., 1987), growing at a rate of nearly 10% per year.

A striking difference between these two marketplaces lies in the percent of the total telecommunications services market open to competition. In Canada it is estimated that at present less than 10% of the total market is open to competitive service provision as compared to nearly 50% of the total United States services market which includes competition into intraLATA services and alternative local access providers.

This paper will provide a historical perspective on the developing trend toward a more competitive environment in Canada (which parallels recent developments in other countries competitive telecommunications policies including the United Kingdom, Japan, and now Mexico), and the resulting effect on United States-Canada telephone services. At issue is whether regulation or competitive market forces will dominate the future direction of services in the transborder market.

3.0 THE CANADIAN TELECOMMUNICATIONS ENVIRONMENT

3.1 THE MARKETPLACE

As in United States, the last few years have produced a rapid transition to digital transmission and "all-digital" services in Canada. This has led to an increasing demand for specialized corporate networks (particularly for transborder United States-Canada services).

However, while the telecommunications industry in the United States has experienced dramatic changes as a result of the AT&T Divestiture and open competition to facilities based carriers, the introduction of competitive services in Canada has been slow in evolving and has often been characterized by extreme caution on the part of regulators who have often viewed the United States competitive experience as opening up "Pandora's Box".

Canada's basic telephone service has traditionally been supplied by a network of telephone companies, both privately and publicly owned, each of which has historically enjoyed a monopoly over the provision of telephone service in its distinct geographic operating territory. The ten principal carriers have banded together in a consortium known as Telecom Canada to ensure the coordination of their networks in the provision of national and international telecommunications services. Other inter-provincial and transborder services such as private line voice, facsimile, data transmission, other enhanced and value-added services, and cellular service have been opened up to at least limited competition.

Within Canada, the two major providers of transborder United States-Canada telephone services are Telecom Canada and CNCP Telecommunications ("CNCP").

3.2 TELECOM CANADA

Telecom Canada is an association comprised of nine local provincial telephone companies and Telesat Canada, the country's domestic satellite provider. Telecom Canada coordinates a national network for the provision of inter-provincial and transborder United States-Canada long distance services. Revenues are distributed amongst the member companies according to a revenue sharing plan, and Telecom Canada provides coordinated national marketing efforts for the member companies.

Telecom Canada completed its trans-Canada digital network in 1987 and offers a full range of services including MTS and WATS, private line, and data services including Megastream, which combines voice, data and image transmission, Dataroute, providing dedicated digital transmission service, and Datapac, a public packet-switched network service. Telecom Canada is managed by a central organization in Ottawa which is staffed by employees from the member companies.

3.3 CNCP TELECOMMUNICATIONS

CNCP is a specialized common carrier carrier operating under federal regulation. CNCP is now privately owned with Canadian Pacific, Ltd. owning 60% of the company and Rogers Communications, Inc. the other 40%. CNCP was originally formed as a result of the evolving telecommunications requirements of Canada's two national railroads, privately owned Canadian Pacific Railway and federally owned Canadian National Railway, with the organizations jointly constructing a national microwave system in the early 1960's.

CNCP provides voice private line, telex services throughout Canada, facsimile, store and forward facsimile, packet switching networks and services, international virtual private network service ("VPN"), corporate digital switched networks VSAT, as well as telegram and money order services. Cantel, an affiliated company under Rogers Communications, is the national supplier of cellular services in Canada which competes with the wireline telephone companies' cellular operations.

In addition to a nationwide analog microwave network, CNCP operates a nationwide digital network with fiber optic transmission between Quebec City-Montreal-Ottawa-Toronto-London-Windsor and across the border to Detroit. Additionally, fiber runs from Edmonton to Vancouver in western Canada with the two networks interconnected via digital microwave between Toronto and Edmonton.

CNCP operates a national digital switched network offering Broadband Exchange Services ("BES") providing national and international corporate telecommunications networks to major corporations throughout Canada. However, there are some major restrictions on this service within Canada. CNCP is not allowed to connect this network to the public switched telephone network ("PSTN") for the purpose of originating or terminating voice traffic. Therefore, within Canada, all connections to the network for MTS-like services are by direct access lines (DALs) only. No such restrictions are placed on the termination of southbound Canada to United States traffic via arrangements with U.S. Sprint, Allnet, and MCII, or for the termination of overseas international traffic via Teleglobe Canada, Canada's designated international carrier.

There is also a second type of service provided by CNCP on its BES network. As a result of a recent decision in the Canadian Radio-television and Telecommunications Commission ("CRTC"), CNCP is now able to connect its network to the PSTN for data services, i.e., facsimile. CNCP has been required to implement some technical safeguards to ensure the service is restricted to data only. CNCP is now in a position to terminate international inbound facsimile on a ubiquitous basis throughout Canada and will pursue this possibility with various international administrations.

4. THE CANADIAN REGULATORY SCENE

4.1 COMPETITIVE SERVICE EVOLUTION

In the past decade, the monopoly telecommunications services environment in Canada has been eroded in a number of important respects.

In 1979, the CRTC approved an application by CNCP Telecommunications to interconnect its private voice and data networks with the local telephone exchange networks of Bell Canada and British Columbia Telephone Company which serve about 80% of telephone subscribers in Canada. This enabled CNCP to offer dial-up access through local exchanges to its dedicated voice services and both its dedicated and switched data services. However, CNCP was prohibited from offering public voice services (MTS and WATS) in competition with Canadian telephone companies.

In 1985, two other competitors entered the fray. Canada's domestic satellite carrier, Telesat, was permitted to market its data and private voice services directly to the public rather than through the telephone companies as formerly the case, and B.C. Rail, a regional carrier, was permitted to interconnect its network to the PSTN in British Columbia to provide private voice and public data services. Like the telephone companies, CNCP and Telesat Canada are rate regulated. Thus, Canada currently enjoys a form of regulated competition in the provision of private voice and public data services.

In 1980, the CRTC allowed terminal interconnection with respect to both single and multi-line terminals, including PBX and key equipment. Attachment of computer equipment to private line services had been allowed prior to 1980. The terminal interconnect business is now a highly competitive one in Canada. The Canadian Standards Association administers a uniform set of technical standards for terminals and independent laboratories and has been certified for carrying out type approvals of new equipment. Some such labs have been approved to operate in the United States as well as in Canada.

In 1985, the CRTC allowed the interconnection of privately owned local area networks (LANs) to the public switched telephone network allowing dial-up communication from privately owned networks. The only restriction on the use of LANs is that they cannot be used to offer voice services to the public. There are no restrictions on data applications. This regulatory development has led to limited competition from some cable television companies in the provision of local network services.

4.2 RESALE/SHARING SERVICES

In 1984, the CRTC allowed the provision of enhanced telecommunications services on an unregulated basis by non-carriers. This enabled service providers to resell basic telecommunications services in the course of providing some enhanced form of service other than basic transmission service. Unlike the situation in the United States, the telephone companies are allowed to compete in the enhanced service market either on a regulated basis through the public utility itself or on an unregulated basis through an arms-length subsidiary.

In 1987, the rules governing resale and sharing activity were further liberalized. As a result, reseller and sharing groups are now permitted to provide all forms of data services on an unregulated basis using underlying facilities furnished by the regulated carriers. However, the rules governing the provision of voice services by resellers are more restrictive and currently prevent resellers from providing MTS/WATS equivalent services. Resale activity in the voice market is, therefore, largely limited to private line services.

The limitations on resale of voice services has led to a number of regulatory challenges involving reseller and sharing groups with the telephone companies seeking to shut down resale operations and the resellers seeking to further liberalize the rules. As a result, resale activity has not developed in Canada at the same pace as it has in the United States. For instance, the operations of two of the largest resale/sharing operations (Call-Net Telecommunications Ltd. and STM Systems Corp.) have been attacked by Bell Canada as operating outside the rules. The CRTC is currently considering whether to liberalize its resale rules to permit the provision of MTS equivalent services. A decision is likely to be made in a few months.

One anomaly of the Canadian resale rules is that they permit a wider range of voice services to be provided from Canada to United States destinations than from United States to Canada destinations. This is because Canadian resellers can obtain access to MTS/WATS networks in the United States for termination of traffic to United States destinations. The Canadian rules prohibit United States resellers terminating traffic destined for Canada in the same way.

This was recently illustrated in a regulatory proceeding involving CNCP and Allnet Communication Services, Inc. (a United States carrier/reseller). CNCP was using Allnet to terminate in the United States traffic that was originated on CNCP's private broadband network in Canada - something that CNCP is allowed to do under Canadian regulations. Allnet, on the other hand, was not permitted to use CNCP's facilities to terminate traffic in Canada that it had originated on its virtual private network in the United States. A similar situation exists for other resellers with Canadian resale activities having to concentrate largely on southbound traffic.

4.3 SWITCHED VOICE SERVICES

The issue of MTS/WATS competition has already come before the CRTC on one occasion. In August of 1985, the CRTC denied an application by CNCP to provide public switched long distance voice services in competition with the two principal federally regulated telephone companies.

While finding that competition in this market would be in the public interest, the CRTC found that CNCP would not be able to realize its service objectives if it were required to contribute the same level of toll revenues as the other telephone companies to subsidize the cost of local access service. The CRTC was not prepared to abandon its policy of subsidizing local access service with toll revenues and would not allow CNCP to compete on terms more favorable than existing telephone companies.

CNCP is now poised to reapply for permission to provide a competitive MTS/WATS service in Canada and is expected to file its application within the next few months. If CNCP is successful this time around, we will likely see competitive services introduced in 1992.

4.4 JURISDICTIONAL ISSUES

Until recently there had been divided regulatory jurisdiction over Canada's telecommunications carriers. The operations of some carriers were regulated at the provincial level, while others like Bell Canada, B.C. Telephone, and CNCP were regulated at the federal level by the CRTC. The ten member companies of Telecom Canada were regulated by eight different regulatory agencies with differing regulatory policies. This led to varying degrees of telecommunications competition across Canada and made the introduction of competitive services on a national basis virtually impossible.

In August 1989, the Supreme Court of Canada issued a landmark decision delineating a wider role for federal regulation. In October 1989, the Federal Minister of Communications tabled new legislation that will have the effect of bringing all the Telecom Canada member companies under CRTC jurisdiction.

By bringing the ten Telecom Canada member companies under the authority of a single regulator, the expectation is that uniform, national regulatory policies will be developed by the federal regulatory authority. This will have particular significance for the development of national competitive services by carriers like CNCP.

4.5 A TELECOMMUNICATIONS POLICY FRAMEWORK

Notwithstanding these regulatory developments, public switched voice services remain the monopoly preserve of the telephone companies. This has produced a rate structure in which local telephone service is relatively inexpensive and long distance service is relatively expensive. The policy of offering a flat rate local telephone service at low cost has formed the historic cornerstone of regulatory policy in Canada. It has had a lot to do with Canada achieving a level of penetration that makes telephone service virtually universally available. Reasonably priced local telephone service is now widely regarded as a social and economic right of all Canadians.

Deregulation of the long distance market in the United States has brought pressure to bear on the relatively high cost of long distance services in Canada which, in many mileage bands and time periods, are more than double the price of comparable services in the United States competitive market (Figure 1). It is interesting to note however, that transborder Canada to United States rates are now comparable with competitive United States to Canada transborder rates except for short haul bands where Canadian rates are still higher (Figure 2).

As telecommunications expenditures become a more important element in the total budget of businesses, this price differential between Canadian and United States rates has begun to have an increasing impact on the ability of some Canadian businesses to compete with their American counterparts in the North American market and to respond fully to opportunities presented by the advent of the information age.

This situation has led to calls from the business sector for the introduction of more competition in the Canadian market. For their part, the telephone companies have responded with proposals for "rate rebalancing" rather than competition. This involves the "rebalancing" of local and long distance rates - that is the lowering of long distance rates and the raising of local rates to bring them both more into line with associated costs.

While several rate rebalancing proposals have been considered by the CRTC, it has not yet sanctioned an increase in local rates to offset a decrease in long distance rates. Recent growth in demand for long distance service has enabled the telephone companies to institute reductions of 30% to 40% in MTS/WATS rates over the past three years without a corresponding increase in local rates. The telephone companies argue that this type of rate reduction negates the need for MTS/WATS competition.

While the Canadian Government would like to see more competition in the telecommunications sector, it subordinates this goal to other policies, such as the continued availability of efficient low-cost telephone service at an affordable price. The government has stated in plain terms its disinclination to blindly follow the United States example. The CRTC has no clear mandate to favor the introduction of competition in the telecom sector. It is mandated to determine when interconnection of networks

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Figure 1

Per Minute Domestic Rate Comparison *
($ U.S. Dollars)

City Pairs	**Rate Period**	**Canada - Canada Toll**		**U.S. - U.S. Toll**	**Percent Difference**
		Canadian Dollars	U.S. Dollars		
Short Haul Calls					
Montreal-Ottawa					
(102 miles)	Day	40¢	34.0¢	20.60¢	65.0%
Philadelphia-Baltimore	Evening	26¢	22.1¢	14.49¢	52.5%
(90 miles)	Night	16¢	13.6¢	10.49¢	29.6%
Medium Haul Calls					
Ottawa-Windsor					
(424) miles)	Day	53¢	45.1¢	22.55¢	100.0%
Chicago-Buffalo	Evening	34¢	29.3¢	15.49¢	89.2%
(450 miles)	Night	21¢	18.0¢	11.49¢	56.7%
Long Haul Calls					
Toronto- Vancouver					
(2,092 miles)	Day	57¢	48.5¢	23.51¢	106.3%
New York-Los Angeles	Evening	37¢	31.5¢	15.49¢	103.4%
(2,450 miles)	Night	23¢	19.4¢	12.49¢	55.3%

** Based on rate comparisons between Telecom Canada (Bell Canada) Canada - Canada message toll rates (10/02/89) and MCI Telecommunications Corp. Dial "1" rates (at the highest level of Volume Discounts of 4% for the Day rateperiod) between similar mileage band city pairs with Canadian rates adjusted to reflect U.S. dollars (85¢ Canadian to$1 U.S. Dollar).*

Figure 2

Per Minute Transborder Rate Comparison *
($ U.S. Dollars)

City Pairs	**Rate Period**	**Canada to U.S.**		**U.S. to Canada**	**Percent Difference**
		Canadian Dollars	U.S. Dollars		
Short Haul Call					
	Day	43.0¢	36.5¢	32.0¢	14.1%
Vancouver-Seattle	Evening	28.0¢	23.8¢	22.3¢	6.7%
(119 miles)	Night	17.2¢	14.6¢	17.3¢	<15.6%>
Medium Haul Call					
	Day	52.0¢	44.2¢	41.6¢	6.3%
Toronto-New York	Evening	33.8¢	28.7¢	29.8¢	< 3.7%>
(343 miles)	Night	20.8¢	17.7¢	22.9¢	<22.7%>
Long Haul Call					
	Day	63.0¢	53.6¢	63.0¢	<14.9%>
Montreal-Los Angeles	Evening	41.0¢	34.8¢	44.8¢	<22.3%>
(2,467 miles)	Night	25.2¢	21.4¢	34.9¢	<38.6%>

** Based on rate comparisons between Telecom Canada (Bell Canada) Canada - United States message toll rates (10/02/89) and MCI Telecommunications Corp. Dial "1" rates (at the highest level of Volume Discounts of 10% for the Day rate period) between similar mileage band city pairs with Canadian rates adjusted to reflect U.S. dollars (85¢ Canadian to $1 U.S. Dollar). Average length of calls for the Day, Evening, and Night rate periods of 3, 4, and 5 minute calls respectively.*

is in the "public interest", broadly defined. To do so, it must weigh the benefits and detriments.

5. PARALLELS WITH OTHER INTERNATIONAL MARKETS

The traditional method of international service provision through and between monopoly telephone providers has undergone drastic changes in the last decade. With the entrance of competitive carriers such as CNCP in Canada, Mercury Communications in the U.K., IDC and ITJ in Japan, as well as the development of private undersea fiber optic cable systems and satellite services, the market has opened considerably.

It is possible that the Canadian telecommunications structure may be developing in a manner similar to that in the United Kingdom. In the United Kingdom, a duopolistic systems has developed where a formerly state controlled monopoly provider (British Telecom) is licensed and must provide services throughout the Country, and a second major "alternative" carrier (Mercury) is licensed to provide service on the basis of "commercial feasibility". A federal regulator has been established to ensure that full and fair competition develops within the market without any abuse of position of strength by the former monopoly carrier.

There also appears to be many similarities between the development of competitive telecommunications services in Canada and Mexico, and in particular between CNCP and Mexican state run TELECOMEX and TELENALES (which are soon to be merged). Both companies were initially developed under governmental auspices with networks originally established for telex and data services. Now it appears each might take the lead in developing and offering competitive switched voice/enhanced services in their countries.

Similar to the United States market, it is expected that smaller resale and facility based carriers will emerge providing services on a more regional basis. However, based on the concentration of Canadian population in approximately 10 major metro areas, less opportunities exist in Canada to set up niche market operations with high volumes of traffic between a few regional points. The route between Windsor - Toronto - Ottawa - Montreal - Quebec City is the key market within Canada for interprovincial traffic, and it is doubtful the CRTC will encourage open market entry or that the market can support an unlimited number of competitors.

6. UNITED STATES-CANADA TRANSBORDER SERVICE DEVELOPMENT

6.1 SWITCHED VOICE COMPETITIVE SERVICES ON THE ROUTE

Within the United States-Canada transborder switched voice markets the three key players include AT&T, MCII, and U.S. Sprint. These carriers have established direct interconnection arrangements with Telecom Canada, the monopoly long distance carrier, and have digital facilities linking across the border. Other United States regional interexchange carriers also serve Canada, primarily on a resale basis. Rates for long distance, United States-Canada and overseas international services have continued to fall while overall usage is increasing.

In the United States-Canada transborder services market, Telecom Canada broke tradition in 1982 by entering into an agreement with MCI for an initial transborder market trial called Teleplus 1022. Previously, AT&T had been Telecom Canada's sole correspondent for transborder MTS services. This represented the first interconnection agreement for direct voice services between an international administration and a United States competitive carrier. Shortly after the MCI Teleplus 1022 market trial was completed, Telecom Canada also entered into agreement with U.S. Sprint and Satellite Business Services (which was later purchased/merged with MCII).

Initial agreements with these carriers were on a one-way northbound only basis with settlement on a revenue sharing schedule in contrast with the Parallel Circuit Rule as established by the United States Federal Communications Commission mandating the same settlement rate be set to a country for "like" services, preventing "whipsawing" by PTTs. MCI and U.S. Sprint eventually were able to expand their arrangement with Telecom Canada to include termination of return southbound traffic at the same peak/off-peak settlement as AT&T with reimbursement to Telecom Canada for the administrative costs of reconfiguring the network to handle return traffic allocation. Most recently, the International Carrier Group, a consortium of United States carriers including Allnet, Cable & Wireless N.A., ITT/Metromedia, and Telecom*USA, have announced their intention to enter into an agreement for northbound transborder MTS with Telecom Canada.

On the United States-Canada route CNCP has established digital interconnections using fiber and digital radio with AT&T, MCII, U.S. Sprint, Rochester Communications, QWEST, and WTCI and has service agreements with those carriers in addition to Cable & Wireless N.A., Allnet, Telecom*USA, Metromedia, Telenet, and TRT/ FTC Communications. Services provided include Southbound Broadband Exchange Service, facsimile, and telex and data services.

6.2 TRANSBORDER SATELLITE SERVICES

Domestic and international satellite carriers are also providing limited competitive services on the Canada - United States transborder route. Under a 1982 agreement between the Canadian and Untied States governments, Telesat Canada and the United States domestic satellite providers ("DOMSATs") are permitted to provide transborder telecommunications services. The agreement requires coordination of services by the DOMSATs and equitable use of both country's satellite facilities. At present, these services are limited to private network services.

The Canadian Department of Communications is currently considering a proposal to liberalize its earth station ownership policy to permit customers of Canada - United States satellite services to own and operate their own earth stations.

Teleglobe Canada, Canada's designated overseas carrier, is also providing limited communications services on the United States-Canada route. Teleglobe is currently permitted to provide triangular services between Canada/ United States/Overseas destinations and has recently requested regulatory permission to provide Canada-United States fax service as part of its international GlobeFax service.

The increased activity of the satellite carriers will further stimulate competition on transborder telecommunication routes.

6.3 FUTURE DEVELOPMENTS IN TRANSBORDER VOICE SERVICES

If the Canadian MTS/WATS market is opened to competition, it is expected that some realignment of transborder United States-Canada traffic will take place. Specifically, CNCP, with its digital network and fiber optic transmission facilities in place, is well positioned to extend their current operating arrangements with United States carriers to include transborder MTS/WATS. With competitive operating environments on both sides of the border previous barriers to entry against United States carriers would be lessened (i.e., limited interconnection with a monopoly carrier, achieving certain thresholds of traffic, and allocation of return traffic).

It is possible a downward trend in settlement rates on the United States-Canada route will develop based on several factors. First, competitive entrants into the marketplace on both sides of the border might lead to a decrease in rates. It is possible that as CNCP is allowed to enter into the transborder MTS/WATS market Telecom Canada might respond with a lower settlement rate.

Secondly, increased erosion in the demand for transborder MTS/WATS services from large users is expected based on "Technology Bypass". Specifically, with the introduction of digital technology and competitive services a new breed of sophisticated user has been developing. Large users are expected to continue to bypass the traditional service and settlement systems by establishing two-way transborder networks linked together with FXs, private lines, and other high speed facilities often including their own switching capabilities, or using leasing switching capacity on a VPN basis or on a software defined network basis. As evidence of this trend, the United States-Canada market has the single largest amount of private lines between any two international locations with customer private line facilities in excess of 10,000 voice grade lines.

Third , strategic alliances and joint ventures between United States and Canadian companies and carriers with minority foreign ownership in each others systems is likely to increase and flourish. It is possible that the traditional international service arrangements will be transformed into minority interest positions as ways of building strategic alliances and joint marketing, creating a situation where settlements can in effect become basically a "transfer price" between commonly owned companies.

On the United States side, it is expected that the Local Exchange Carriers ("LECs"), InterExchange Carriers ("IXCs"), and Regional Bell Operating Companies ("RBOCs") in particular will be actively looking for ownership interest in Canadian systems (similar to Pacific Telesis' ownership in IDC in Japan and other RBOC ownership/consortium participation in other related businesses such as cable and cellular systems in foreign countries). With the opening up of the competitive telecommunications service markets in both Canada and Mexico, it is likely that United States IXCs and LECs will try to form North American strategic alliance positions with minority ownership interest in Canadian and Mexican carriers. It is expected however, that foreign ownership in Canadian carriers will soon be limited to 20% by legislation. Canadian companies will enjoy a myriad of partners/investments opportunities in the United States with the numerous carriers operating within the United States competitive environment.

These factors may serve to drive the traditional accounting system to more properly reflect the actual cost for termination of traffic rather than artificially set settlement rates. Although the United States to Canada market has for the most part been a balanced stream cancelling out settlement payments (i.e., equal levels of traffic are flowing southbound from Canada to the United States as well as northbound from the United States to Canada), the entrance of competitive carriers in Canada may cause an imbalance between interconnected non-dominant carriers.

For example, Mercury Communications growth is constrained on the United States-United Kingdom route by virtue of its own domestic market share in the United Kingdom and by operating under the system of proportional return traffic allocation. Mercury is limited in its ability to attract United States carriers and United States carriers are limited in their ability to achieve maximum profitability on the route without a fair share of proportional return traffic.

While settlement rates become irrelevant as two-way traffic levels are balanced and settlement payments are canceled out, it is the expectation and realization of an imbalanced traffic stream (i.e., out:in traffic ratio) that makes the traditional settlement rate arrangement unfavorable between two non-dominant carriers.

As one possible solution, the traditional international settlement rate for a route might be utilized up to the point where proportional traffic is provided in accordance with the out:in ratio experienced on the route. Any imbalance of traffic over and above the out:in ratio level might be terminated at a reduced settlement/termination rate. This would compensate for the high revenue return normally associated with inbound traffic as outbound traffic is usually provided on at best a break-even basis. When no return traffic is provided, settlement would simply become a reduced settlement rate more accurately reflecting the cost of one-way termination.

Based on current Canadian regulatory constraints, CNCP essentially provides southbound BES service to the United States with limited United States northbound termination capability with the exception of facsimile traffic (i.e., FXs must be dedicated back to the United States customer). CNCP's current arrangements with United States carriers for BES traffic provide for a lower or differential accounting arrangement of 16.5¢/14.5¢ peak/off-peak rate as compared with the current United States-Canada MTS services settlement rate of 21¢/19¢ peak/off-peak rate (between Telecom Canada and AT&T, MCII, and U.S. Sprint).

One might envision in the future United States-Canada settlement rates may be as disaggregate and complex to include time of day/day of week, mileage, and volume sensitive components to more reflect the cost of service on a bidirectional basis. It is possible that these factors could pressure settlement rates to decline to a level more accurately reflecting the actual cost of termination in a particular country.

7. CONCLUSION

The importance of Canada, the United States, and Mexico as neighbor's and trading partners linked by strong cultural and commercial ties will be a catalyst in the stimulation and development of new and innovative telecommunications services between the borders.

It is likely that strategic alliances based on minority or cross ownership interests between carriers in these three countries will develop, producing innovative service and facility arrangements which will result in greater customer service selection at lower rates. With CNCP's application for MTS/WATS competition expected early next year, continued consolidation of carriers in the United States competitive environment, and the expected privatization of Telefonos de Mexico and opening up of competitive services in Mexico, the decade of the 1990's should be a turning point in the development of telecommunications services in the North American continent. Similar to the economic consolidation of the the European market, telecommunications service providers will benefit as economic and commercial ties are strengthened in the North American economic sector.

Session 5.5

Disaster Management

NOTES

Disaster and Emergency Exercises
Sponsored By
The National Communications System

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National Communications System
Washington, D.C.

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The Aerospace Corporation
Washington, D.C.

1. ABSTRACT

The National Communications System (NCS) sponsored two disaster scenario exercises during 1989 -- a simulated hurricane in Pinellas, Florida and a simulated earthquake in Anchorage, Alaska. Through these exercises the NCS validated concepts for using Commercial SATCOM Interconnectivity (CSI) assets as the Public Switched Network (PSN) gateway of a transportable telecommunications system. These exercises demonstrated the applicability of using transportable cellular and satellite systems to restore telecommunications service to NS/EP users isolated during emergencies and disasters. These exercises and other ongoing experiments fulfill an essential, mission element of the NCS -- "to coordinate the planning for and provision of the National Security and Emergency Preparedness communications for the federal government under all circumstances including crisis or emergency."

2. NATIONAL COMMUNICATIONS SYSTEM (NCS)

2.1 BACKGROUND

The NCS is a confederation of 23 federal departments and agencies assigned NS/EP telecommunications responsibilities throughout the full spectrum of emergencies. These responsibilities include planning and programming enhancements to the national telecommunications infrastructure and improving the management and use of national telecommunications resources to support the government during any emergency.

The NCS was established by Presidential Memorandum in 1963 in response to interagency telecommunication problems encountered during the Cuban missile crisis. It was reaffirmed by Executive Order (E.O.) 12472, "Assignment of National Security and Emergency Preparedness Telecommunications Functions" (Figure 1) in 1984. Additional policy direction is set forth in National Security Decision Directive (NSDD) 97, "National Security Telecommunications Policy."

The Office of the Manager NCS (OMNCS) is organized into four functional areas: Office of NCS Plans and Programs; Office of NCS Technology and Standards; Office of NCS Emergency Preparedness; and Office of the Joint Secretariat (Figure 2). The Office of NCS Plans and Programs is responsible for the National Level Program.

2.2 NATIONAL LEVEL PROGRAM (NLP)

As the keystone planning element of the NCS, the NLP provides means to ensure the availability of NS/EP telecommunications. Currently, the NLP focuses on three high priority, high impact programs:

NETS	Nationwide Emergency Telecommunications Service
CNS	Commercial Network Survivability
CSI	Commercial SATCOM Interconnectivity

The disaster exercises and technology experiments discussed below demonstrate the use of specialized equipment, technologies, and configurations that support the CSI element of the NCS NLP. These exercises demonstrated the flexibility in using CSI assets for non-standard applications. The exercises used commercially available telecommunications equipment, packaged and set up in a unique configuration, to fulfill the telecommunication requirements of NS/EP users. This exercise summary highlights the technology-challenges and opportunities in using satellite facilities as gateways to the public switched networks.

3. NCS DISASTER EXERCISES

The NCS conducts communications exercises to determine feasibility and proof-of-concept of

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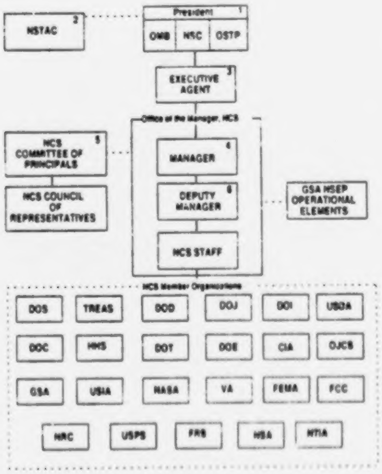
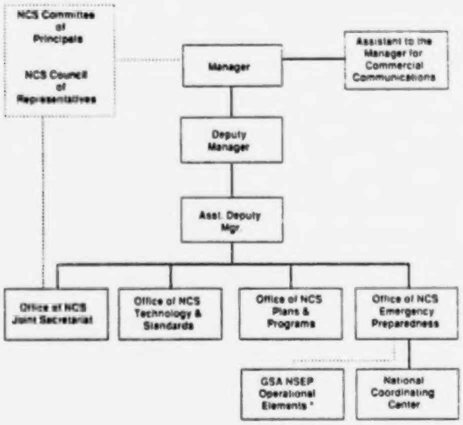

President
1
OMB
NSC
OSTP
NSTAC
2
EXECUTIVE AGENT
3
Office of the Manager, NCS
MANAGER
4
DEPUTY MANAGER
6
NCS STAFF
NCS COMMITTEE OF PRINCIPALS
5
NCS COUNCIL OF REPRESENTATIVES
GSA NSEP OPERATIONAL ELEMENTS
NCS Member Organizations
DOS
TREAS
DOD
DOJ
DOI
USDA
DOC
HHS
DOT
DOE
CIA
OJCS
GSA
USIA
NASA
VA
FEMA
FCC
NRC
USPS
FRB
NSA
NTIA

NCS ORGANIZATIONAL CHART

1 Policy Direction and Direct Execution of War Powers Functions
2 National Security Telecommunications Advisory Committee
3 Executive Agent NCS Responsibilities Assigned to Secretary of Defense by E.O. 12472 April 3, 1984
4 Director DCA Serves As Manager, NCS
5 The Key Telecommunications Officers of the NCS Member Organizations
6 First Line Management Position Which is Exclusively NCS

LEGEND
DIRECTION ————
COORDINATION ··········

Figure 1


NCS Committee of Principals
NCS Council of Representatives
Manager
Assistant to the Manager for Commercial Communications
Deputy Manager
Asst. Deputy Mgr.
Office of NCS Joint Secretariat
Office of NCS Technology & Standards
Office of NCS Plans & Programs
Office of NCS Emergency Preparedness
GSA NSEP Operational Elements *
National Coordinating Center

OFFICE OF THE MANAGER, NCS

LEGEND
DIRECTION ————
COORDINATION ··········

NCS REGIONAL EMERGENCY TELECOMMUNICATION PLANNERS AND REGIONAL EMERGENCY TELECOMMUNICATION MANAGERS

Figure 2

approaches to crisis and disaster management. Two major exercises were conducted in 1989: the Pinellas Exercise and Exercise LAST MILE '89.

3.1 PINELLAS EXERCISE

The Pinellas exercise evaluated the use of a ground-transportable cellular system to support communications requirements for emergencies and disasters, and assessed the performance of CSI satellite interconnects for access into the PSN. The scenario simulated that a class 5 hurricane disabled local telephone service around the Department of Energy (DOE) site at Pinellas, Florida, and that DOE emergency communication services were disrupted.

A transportable Mobile Telephone Switching Office (MTSO) and cell were transported by road and set up at the DOE Pinellas facility to provide cellular coverage for NS/EP users (Figure 3) during the exercise. The MTSO was connected to an Alascom transportable C-band terminal outfitted with a CSI modem via a Digital Microwave Corporation (DMS) 23-GHz digital microwave link. The C-band terminal connected the MTSO traffic, via the Aurora satellite, to a Pacific Bell Telephone Company end office in Sacramento, California.

At the Sacramento end (Figure 4), the traffic was downlinked to the Contel/ASC CSI Vallejo earth station complex and from there to the Contel/ASC central office at the KOVR-TV station in Sacramento via the Contel/ASC CSI microwave. There, it entered the local exchange carrier (LEC) transmission facilities and was passed to a Pacific Bell end office.

The MTSO, using the line code assigned from the Pacific Bell switch and the Pacific Bell Numbering Plan Area (NPA) area code and central office codes, functioned as a foreign exchange off of the Pacific Bell switch. Thus, the Pinellas NS/EP users could make local calls in the Sacramento Local Access Transport Area (LATA) and long distance calls via Sprint, the specified interLATA carrier.

3.2 EXERCISE LAST MILE '89

The Alaska exercise provided training for responding to civil disasters, of long duration, involving large areas and multiple government agencies. It concentrated on assessing a catastrophic situation and allocating scarce resources to meet the situation.

This exercise also evaluated the use of mobile and fixed wireless systems to support emergency and disaster communication requirements. Further, enhancements to the CSI satellite interconnects, satellite frequency bandwidth conservation, and PSN access were evaluated.

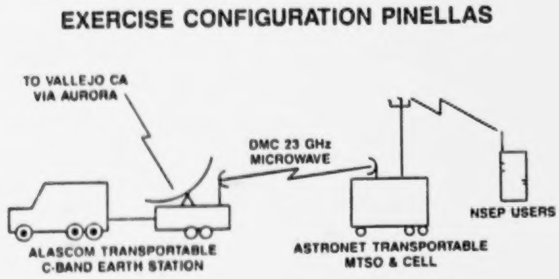

EXERCISE CONFIGURATION PINELLAS
TO VALLEJO CA
VIA AURORA
DMC 23 GHz
MICROWAVE
NSEP USERS
ALASCOM TRANSPORTABLE
C-BAND EARTH STATION
ASTRONET TRANSPORTABLE
MTSO & CELL

Figure 3

In the diaster scenario, an earthquake measuring 7.3 Richter-scale occurred along the Range Borders Fault near Anchorage/Turnagain/Portage. Heavy damage was simulated to structures of all kinds within 49 miles of Anchorage. The port of Anchorage was assumed massively damaged and fuel spills and heavy onshore fires made it nearly impossible to assess the chaotic situation there. Many casualties occurred within the city and its suburbs; debris from fallen buildings and fractured pavements blocked almost all movements. Assessments of damage were delayed and sketchy, but it was clear that massive external help was needed.

The exercise configuration, as illustrated in Figure 5, involved local (Anchorage area) microwave sites, disaster field offices, supply staging centers, earth stations and switching stations, as well as distant (CONUS) earth stations.

Rabbit Creek Microwave Site -- An air-transportable MTSO and cell were transported to Kulis Air National Guard Base in Anchorage by the Alaskan Air National Guard, and then by road to the Alascom Rabbit Creek microwave site where they were deployed, along with a wireless telephone system to provide cellular and fixed telephone service for NS/EP users. The MTSO and wireless traffic was transmitted to the Alascom toll switch on Government Hill using a DMC 23-GHz digital microwave system.

Cambell Track Field Office -- A Disaster Field Office (DFO) was established at the Department of Interior Bureau of Land Management facility at Cambell Track. DFO communications were provided through the facility's Norther Telecom SL1 PABX, and trunked via a DMC 23-GHz digital microwave link to Rabbit Creek where it was relayed to the Alascom toll switch on Government Hill.

Kulis Supply Center -- A relief supply staging center was established at Kulis ANGB. An Alascom transportable C-band earth station was deployed to Kulis ANGB. The REDCOM PABX installed in the earth station was used to provide the staging center communications. The staging center traffic was also routed to the Alascom toll switch via a DMC 23-GHz digital microwave link. The earth station was also outfitted with a Network Equipment Technologies (NET) IDNX network controller that allowed the combination of the Sacramento DS-1 and McClellan AFB DS-1 traffic onto a single T1 carrier. A CSI modem, a T1 modem selected by the CSI Program to provide baseband to intermediate frequency interoperability, was installed in the earth station to provide baseband interoperability with the CSI earth station at Vallejo.

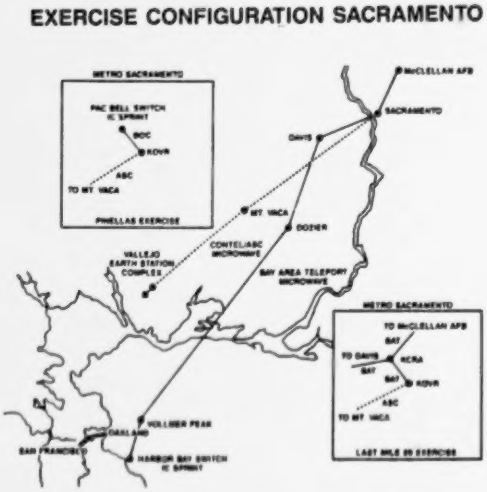

EXERCISE CONFIGURATION SACRAMENTO
METRO SACRAMENTO
PAC BELL SWITCH
IC SPRINT
BOC
KOVR
ABC
TO MT VACA
PINELLAS EXERCISE
McCLELLAN AFB
SACRAMENTO
DAVIS
MT VACA
DOZIER
CONTEL/ABC
MICROWAVE
VALLEJO
EARTH STATION
COMPLEX
BAY AREA TELEPORT
MICROWAVE
METRO SACRAMENTO
TO McCLELLAN AFB
BAT
TO DAVIS
KCRA
BAT
BAT
KOVR
ABC
TO MT VACA
LAST MILE 89 EXERCISE
VOLLMER PEAK
OAKLAND
SAN FRANCISCO
HARBOR BAY SWITCH
IC SPRINT

Figure 4

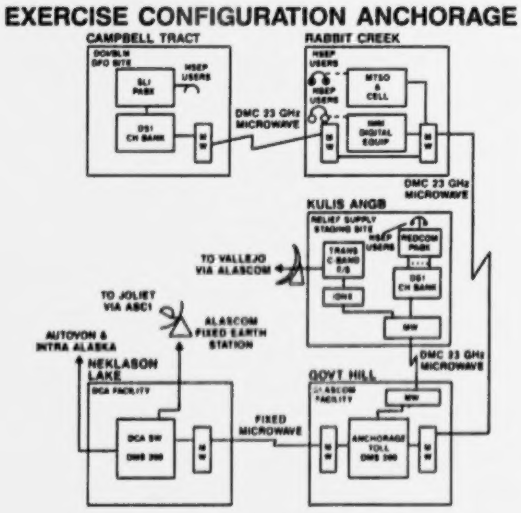

EXERCISE CONFIGURATION ANCHORAGE
CAMPBELL TRACT
DOVBLM
DFO SITE
SL1
PABX
NSEP
USERS
DS1
CH BANK
M
W
DMC 23 GHz
MICROWAVE
RABBIT CREEK
NSEP
USERS
NSEP
USERS
MTSO
&
CELL
DIGITAL
EQUIP
M
W
M
W
DMC 23 GHz
MICROWAVE
KULIS ANGB
RELIEF SUPPLY
STAGING SITE
NSEP
USERS
REDCOM
PABX
TRANS
C-BAND
E/S
DS1
CH BANK
IDNX
MW
TO VALLEJO
VIA ALASCOM
TO JOLIET
VIA ASC1
ALASCOM
FIXED EARTH
STATION
AUTOVON &
INTRA ALASKA
NEKLASON
LAKE
DCA FACILITY
DCA SW
DMS 200
M
W
FIXED
MICROWAVE
DMC 23 GHz
MICROWAVE
GOVT HILL
ALASCOM
FACILITY
MW
M
W
ANCHORAGE
TOLL
DMS 200
M
W

Figure 5

Eagle River -- A CSI modem was also installed at the Alascom Eagle River Earth Station to provide baseband interoperability with the CSI earth station at Jolliet.

Government Hill -- All facilities used line code assigned by both BOC end offices and their NPA and central office codes. The Alascom toll switch on Government Hill was programmed to provide the translations and routing of the NS/EP traffic. It was programmed to route the Intra-Alaska and Autovon traffic to the DCA switch at Neklason Lake, the Eastern CONUS long distance traffic to Chicago via the Alascom Eagle River Earth Station, and the Western CONUS long distance and Autodin traffic to Sacramento and McClellan AFB via the Alascom transportable C-band earth station at Kulis ANGB. A telephone directory, providing the dialing instructions from each facility, was prepared and distributed to the NS/EP users.

Chicago, Illinois Earth Station -- At the Chicago end (Figure 6) the Eastern CONUS long distance traffic was downlinked to the Contel/ASC CSI Jolliet earth station complex. From there, it was routed to the Contel/ASC Chicago central office via a Contel/ASC CSI microwave link where it was interfaced with the LEC transmission facilities and passed to an Illinois Bell end office.

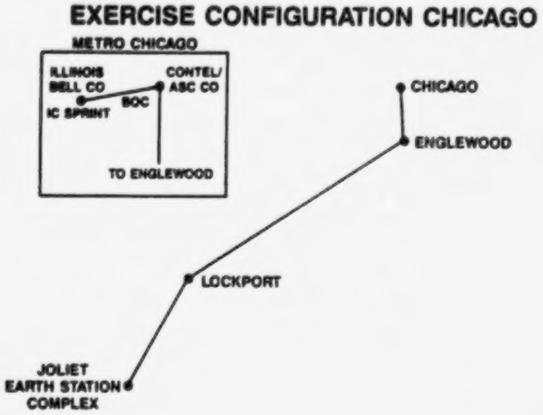


Figure 6

Sacramento, California Earth Station -- At the Sacramento end (Figure 4), the traffic was downlinked to the Contel/ASC CSI earth station at Vallejo where it was processed by an NET IDNX network controller to output 2 DS-1 signals. Both signals were then transmitted to the Contel/ASC central office in Sacramento where they were interfaced with Bay Area Teleport (BAT) transmission facilities and passed to a BAT facility at the KOVR-TV station. Here they were split, the Autodin traffic going to the Autodin switch at McClellan via BAT facilities, and the Western CONUS traffic going to the Harbor Bay teleport switch in Alameda, California.

4. NCS/ADVANCED COMMUNICATIONS TECHNOLOGY SATELLITE

The NCS actively sponsors the application of new technogies that have NS/EP potential, and is supporting the Advanced Communications Technology Satellite (ACTS) Program as an experimenter. Three experimental concepts are under development by the NCS: an ACTS Communications Restoration Experiment, a C-band/Ka-band Gateway Experiment, and a Mobile User Accommodation Experiment.

The ACTS Communications Restoration Experiment will be used to demonstrate ACTS capabilities of performing CSI orderwire functions, accommodating isolated users, and restoring connectivity to damaged elements of the PSN such as InterLATA Carrier Switches, Access Tandems, or End Offices.

The C-band/Ka-band Gateway Experiment will demonstrate the flexibility of the CSI systems to integrate with ACTS technology. An additional element of this demonstration may include the use of the C-band package on a Tracking and Data Relay Satellite System (TDRSS) satellite to demonstrate CSI OCONUS communications capabilities.

Finally, the Mobile User Accommodations experiment will demonstrate the use of high gain spot-beam features of future satellite systems to provide two-way voice and data communications for mobile users.

5. EXERCISE RESULTS AND CONCLUSIONS

Through the Pinellas Exercise and Exercise LAST MILE '89, the NCS successfully demonstrated that transportable mobile and fixed wireless systems can be used to provide government disaster team communications for disasters covering wide areas, extended recovery periods, and that the CSI earth stations and terrestrial facilities can be reconfigured to provide the necessary access into the PSN. This is particularly valuable where local communications systems have been destroyed or did not exist and government disaster teams have to bring in communication systems during the constitution or reconstitution phase.

Recent disasters such as the Exxon Valdez Oil Spill and the Hurricane Hugo Puerto Rico destruction have shown that if government disaster teams are to have communications during the early phases of recovery, they must bring communication systems with them. Refinement of these systems will be explored through the ACTS experiments.

The exercises and ongoing experiments have developed the building blocks for a disaster-communications system. A disaster-communications architecture incorporating these blocks must now be developed and implemented.

These exercises illustrated the importance of the preplanning and contracting for on-call access to the PSN and the pre-planning, pre-testing, and pre-staging of transportable assets to support future contingencies. To this end, the NCS will continue to sponsor the application of new communication technologies and architectures that address the needs of the NS/EP community.

MOBILE SATELLITE DISASTER COMMUNICATIONS SYSTEMS: INTEGRATION STRATEGIES

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Abstract

Disaster management requires inter-agency connectivity through resilient communications infrastructures. Since the mid-1980s, a series of fires, earthquakes and storms have disrupted crucial public and private telecommunications networks. These events have intensified corporate and government concerns that conventional networks are "the Achilles Heel of the Information Society."(1) This paper advocates strategies integrating mobile satellite links into terrestrial and VSAT networks to ensure post-disaster interconnectivity.

Introduction

Telecommunications and disaster management planners alike are facing common challenges in an era of rapid technological change and market liberalization - how to enhance the resiliency of commercial and governmental networks to ensure backup capacity for disaster management. This paper outlines these technological, regulatory and organizational challenges and proposes strategies for integrating mobile satellite services into existing terrestrial networks for crisis communications interconnectivity.

Mobile services are a major growth sector for satellite communications markets. This expanding sector presents opportunities for effective and cost-efficient disaster management interconnectivity through the integration of mobile satellite services into governmental and corporate telecommunications networks. Governments and major corporate telecommunications users share common interests in ensuring the post-disaster functioning of information networks. As prime customers, they should lead the market through planning and procurement of integrated telecommunications networks incorporating mobile satellite links for both normal and emergency use.

The Setting

Jurisdictional - As we have come to expect in the telecommunications field, technology is leading policy. In the United States, regulatory bulldozers have been reshaping the telecommunications landscape since the AT&T breakup, while many disaster management agencies try to find their way to solutions with outdated maps. Consequently, agency jurisdictions and tasks do not fully capture the technological potentials or problems. For example, a recent Los Angeles Times editorial pointed out communications deficiencies and the need for integrated planning among agencies in the aftermath of the October 1989 earthquake:

> California officials must make it a priority to have as foolproof as possible a system of emergency communications with the public in future disasters, especially earthquakes. This must include equipment that can go into operation quickly, by satellite transmission

> if necessary. It also must have public officials available who have ready access to local, regional, state and federal sources of information and can get it on the air without delay.(2)

Asked about the need for integrated telecommunications, one Los Angeles area fire chief commented:

> "Our plan for the 'big one' is to drive around town looking for smoke. No one will be able to communicate."(3)

Within public and private agencies, disaster communication planning is shared between two groups: the technologists and the managers. The technologists' perspective focuses on the communications pathway between the disaster management center and field units. What happens beyond both ends of the pathway was not of primary concern. Meanwhile, the managers assume some kind of pathway will be there when needed in order to perform the required administrative coordination. Their priorities range from maintaining security and restoring essential data backups, to re-establishing infrastructural services (e.g., water, power, sewers, transport, food distribution and banking). Clearly, form must fit function; integrated telecommunications planning is needed in a deregulated environment.

Vulnerability - The 1989 National Research Council report, Growing Vulnerability of the Public Switched Networks: Implications for National Security Emergency Preparedness, identifies the technological and regulatory factors responsible for network failures and service disruptions. It also emphasizes the growing vulnerability of the public switched network (PSN) and the need for greater inter-agency coordination among disaster management agencies.

Dependence - Corporate and government users are increasingly aware of their dependence on telecommunications services for organizational competitiveness and survivability.(4) For example, a 1984 cable fire in Japan disrupted some 89,000 circuits, with total measurable economic losses of about 13 billion yen.(5)

This has fueled whole new market sectors geared to provide system resiliency and service backups. It is quite striking to see advertising campaigns in the United States emphasizing how choosing the wrong telecommunications system will condemn the corporate user to business ruin due to system failure or unreliability. Advertisers evidently believe they have struck a sensitive chord in corporate customers now trying to sort out options in an unforgiving telecommunications market environment. Consequently, senior corporate executives are now among the strongest advocates for integrated governmental-corporate planning for network resiliency and crisis communications.(5)

Lack of Regulatory Incentives - CEO concerns notwithstanding, federal and state policies promoting telecommunications market liberalization are also reducing governmental oversight and financial incentives for building in many resiliency-enhancing features into public networks. For example, the change from rate-of-return to price cap regulatory policies can mean that backup facilities costs come right out of the firm's bottomline profits. This raises concerns whether a deregulating market environment can adequately meet society's disaster communications requirements.

Governmental Role - Two traditional governmental functions are taking two very active, but disconnected roles in disaster communications planning. The first deals with promotion and regulation of telecommunications services for governmental, business and residential customers. The second is the much smaller program for planning and implementing disaster communications strategies - which most often anticipate the use the increasingly vulnerable PSN.(7)

A planning strategy is called for that incorporates both the varied technological alternatives with the strengths of the emerging deregulated commercial market. In this way, financially-constrained governmental agencies can harness both the growing number of technological options with the commercial market's growing dynamism to create incentives for users and providers to ensure system resiliency and interconnectivity required for disaster communications.

MSS Integration Strategies

Strategy 1: Utilize Mobile Satellite Services

The advantages of mobile satellite services (MSS) for overall system flexibility, economy, and reliability are well known. Commercial MSS for distress and safety services have been provided successfully by INMARSAT since the organization's inception. Although the dividing line between mobile, fixed, and radiodetermination satellite services has been blurring for some time, mobile satellite services offer proven advantages for disaster management communications:

1. Interconnectivity among all users.

   The ability of a mobile satellite terminal to track the satellite means that as long as the satellite is in view, the terminal can communicate. This means that the disaster manager can communicate with any unit on the system - trucks, planes, helicopters, ambulances, hospitals, disaster relief agencies, national authorities, etc...

2. Extreme reliability under adverse conditions.

   Thousands of mobile satellite terminals are already installed on ships, planes, and all types of vehicles. Antenna size is minimal, power requirements are met with conventional automobile electrical systems. Moreover, the system continues to operates independently even if a particular system node fails. Even the satellites in the INMARSAT system have satellite backups.

3. Available through commercial and intergovernmental facilities and providers.

   A growing number of MSS providers, equipment manufacturers and software companies are producing mobile satellite networks of increasing power, connectivity, and reduced communications costs. For example, presentations by service providers and manufacturers at the April 1989 Symposium on Disaster Communications in Ontario, California, indicated that completely self-sufficient mobile satellite data terminals would cost as low as $5,000 each.(8) Radiodetermination terminals could cost even less.

Strategy 2: Integrate Mobile Satellite Services with Electronic Mail Information Services

Up to now, high cost and technology constraints have limited disaster planning to the use of surviving terrestrial radio and public telephone service. The advent of low-cost mobile satellite data communications services and electronic mail information networks are enlarging the range of technology choices for disaster planners for resilient disaster communications capabilities.

The 1988 JPL-NASA study on utilizing MSS for crisis communications outlines the feasibility and desirability of integrating MSS with information services.(9) This strategy of combining mobile and information services was successfully demonstrated at the 1984 Los Angeles Olympic Games.

Demonstration of Concept Feasibility: The 1984 Summer Olympics Electronic Messaging System (EMS)

The organizational and financial success of the 1984 Los Angeles Olympic Games is largely due to an inordinately fine match between management and technology, in particular, the communications systems which made it possible to coordinate 35,000 workers and 8,000 athletes dispersed among some 50 sites over 160 miles apart. AT&T's Electronic Messaging System (EMS) consisted of 1700 terminals, 300 printers, and 7000 paging devices connected to 14 minicomputers through radio and fiber optic links. It provided paging, electronic mail, event updates, and athlete information to over 50,000 users dispersed over an area of 4500 square miles.(10)

The EMS performed many of the tasks required from a crisis communications system: interconnectivity between mobile and fixed users, various levels of user access and authorizations, and software specifically designed for the required functions. EMS serves as a model for future emergency communications systems in demonstrating that:

1. **Electronic mail** is a much more efficient resource multiplier than purely voice-oriented systems. Lists of supplies, site addresses, name registers, authorizations and instructions are communicated more efficiently to the intended recipients and among more users than any voice system.

2. **Service integration** between electronic mail, voice, paging and the PSN provides required interconnectivity among disaster management centers and field units.

Strategy 3: Integrate Commercial VSAT Networks into the Disaster Communications System.

Commercial VSAT networks and their thousands of dispersed VSAT nodes represent a major potential communications resource for disaster management.(11) While VSAT networks are normally used for networking electronic mail, cash register data, stock inventories, and credit card authorizations, emergency-equipped VSAT sites could be modified to provide disaster managers with direct data access through the satellite to the network's nodes, the master hub station and central data processing facilities and the PSN.

As with MSS, VSAT networks offer resilient flexibility since network access is provided at every terminal, while failures are isolated to only the affected terminal(s) and not the rest of the network. In the case of hub station failure, pre-arrangements can ensure that other VSAT network hubs operating with the same satellite can assume network control functions. Most importantly for disaster communications, thousands of VSATs can be integrated into the disaster communications network through links between VSAT network hub stations and the disaster coordination center(s).

The Goal: The Integrated Disaster Network

The Integrated Disaster Network incorporates three key elements:

1. Mobile Satellite Services,

2. Data-driven network architecture (electronic mail), and

3. Interoperability with commercial VSAT networks.

Under the Integrated Disaster Network concept, the day-to-day operations of governmental and

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corporate telecommunications and information systems would use MSS and VSAT networks for electronic mail and other data services alongside terrestrial fiber optic network trunks. Following a catastrophic disruption of the terrestrial network, disaster management agencies would use the continuously-operating satellite network for the relief operations and communications.

Roles for Local, State and National Governments

Through advance planning and inter-agency coordination with mobile satellite and VSAT network operators, Pacific rim disaster managers can ensure the interoperability of commercial VSAT and mobile satellite networks with disaster management networks during an emergency.

Case in Point: California

As with most Pacific rim societies, California's 28 million people coexist with the specter of eventual widespread earthquake destruction. The challenges for earthquake disaster management planners are manifold:

(1) To maintain a capability to locate, rescue, and direct medical aid to endangered lives during the first few minutes and hours following the earthquake,

(2) to re-establish and maintain inter-agency coordination to ensure public safety and services, and

(3) to maximize effective use of disaster management resources within the budgets of state and local agencies.

Consequently, the State of California should take the following steps to prepare the state's communications infrastructure for the next major earthquake:

- **Incorporate mobile satellite and VSAT networks as part of the state government's information system planning and procurement.**

  Discussion: During an emergency these resilient links form the disaster communications networks to affected areas. Since they are used in day-to-day operations among administrative units, the emergency network is a constant capability.

- **Establish resiliency and interoperability standards for telecommunications networks analogous to the state's earthquake building codes.**

  Discussion: As discussed above, telecommunications liberalization is reducing regulatory oversight while generating disincentives for infrastructure investment. Resiliency and interoperability standards will ensure that greater portions of the PSN and other networks will continue to function following a major disaster.

- **Establish a Governor's Earthquake Communications Commission to facilitate Mobile Satellite and VSAT network integration through planning and coordination among public/private users and providers.**

  Discussion: The Commission would develop strategies to facilitate Mobile Satellite and VSAT network integration into the state government network. The standards would allow manufacturers to build in VSAT hardware modifications in power supplies (solar panels, generators, and other sources), standardized power and data connectors and interfaces, and software specifically designed for untrained operator use (menu-driven).

- **Encourage private sector participation and investment through tax and other financial incentives (drafting of implementing legislation).**

  Discussion: Tax incentives will promote private sector investment in adapting and making available VSAT networks for disaster function integration at minimal cost to the state government. In this way, participating network operators would realize tax incentives to modify VSAT hardware and software. This should be done on federal, state, and municipal levels.

- **Develop financial, legal, and operating arrangements for VSAT integration.**

  Discussion: These arrangements would compensate VSAT owners and operators for use of the installations during an emergency, establish guidelines for liability and other legal obligations incurred during emergency use.

Each country and region faces its own set of disaster challenges. The California situation presents both a wide spectrum of challenges as well as potential solutions common to many Pacific rim nations.

Summary

Although the PSN is becoming increasingly vulnerable to disruption, technology is also creating new strategy options for providing disaster management interconnectivity. Governmental/corporate network planning and procurement integrating MSS and VSAT network services within an electronic mail framework can ensure that vital societal communications are maintained in the aftermath of major disasters.

Notes

1. Quoted from an article by Naruko Takanashi, et al., "The Achilles Heel of the Information Society: Socioeconomic Impacts of the Telecommunications Cable Fire in the Setagaya Telephone Office, Tokyo," Technological Forecasting and Social Change 34, 27-52, (1988). Spurred on by the AT&T breakup, a growing number of governmental and private efforts have identified the vulnerabilities on the part of network operators and users. See, National Research Council, Growing Vulnerability of the Public Switched Networks: Implications for National Security Emergency Preparedness, (Washington, D.C.: National Academy Press, 1989); The Annenberg Washington Program, "International Disaster Communications: Initiatives for Greater Effectiveness in Mitigating Sudden Catastrophes," monograph submitted to Annual Conference of International Institute of Communications, Washington, D.C., 1988.

2. "Communications Gap," Los Angeles Times editorial, November 12, 1989, p. M6.

3. May 1989 personal interview with Los Angeles area city fire chief. Name withheld on request.

4. See, National Research Council, Growing Vulnerability ...; Chapter 4, "Regulation," emphasizes how deregulation and liberalization is fragmenting the telecommunications infrastructure.

5. Takanashi, et. al., p. 27.

6. Caryn Fox, "Codex Studies Disaster Recovery," Communications Week, May 8, 1989, p. 25.

7. We can see this communications schizophrenia in a recent report published by the State of California. Entitled, "Strategic Direction for Information Technology in California State Government: 1988-1993," the report projects future state government needs while proposing an optical fiber backbone network - one clearly in danger as it passes through numerous earthquake fault zones.

8. See, Tom Kerver, "Mobile at Ku Band Paying Off," Satellite Communications, June 1989, pp. 18-21.

9. Gilbert Duke and Raymond Ehrlich, "MOBILSATCOMM Functional Network Design for Public Safety: FEMA Earthquake Scenario," Jet Propulsion Laboratory and National Aeronautics and Space Administration (JPL D-5316), April 1, 1988.

10. Walter L. Corwin, "A communications network for the Summer Olympics," IEEE Spectrum, July 1984, p. 38.

11. "VSATs help protect network data," Networking Management, November 1989, pp. 75-6; and, James Pruitt and David Kull, Network Contingencies: Trust Not, Suffer Not," Computer Decisions, April 1989, pp. 33-6.

THE MDX IN RURAL ENVIRONMENTS AND SUITABLE FOR EMERGENCY SERVICE

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INTRODUCTION

As in many technical environments, small doesn't necessarily mean less. The sophistication of switching systems applied to the rural market rivals those applied to the large metropolitan areas. The technology is changing rapidly and technological advances are applied to either environment.

The major areas during the last and next years center around LSSGR with equal access, Signalling System 7, and ISDN (Integrated Services Digital Network). It is too early to say which of those major system attributes will be "needed" and at what percent level. But as in so many instances, market driven attributes project the perceived need which quite often is reduced drastically in real applications when considered under a cost/benefit study. Considerations therefore make it mandatory that systems developers allow future additions without making the currently purchased equipment obsolete.

Redcom has developed, over the last decade, a technology based on its Modular Switching Unit (MSU) which allows great freedom to add new attributes as well as allowing expansion to larger sizes. Most recently the MDX-10K using an Expanded Switching Unit (XSU) was introduced. It creates the window to add ISDN and SS7 to the MDX, in addition to allowing growth to about 10,000 ports.

Redcom's distributed systems architecture also allows packaging of the system in individually self-contained functional segments for emergency applications, in natural and manmade disasters.

Another product, the Modular Switching Peripheral (MSP), may offer added advanced features as an adjunct to existing systems of other manufacturers which may not easily be retrofitted.

THE MDX TECHNOLOGY

Redcom's technology centers around fully distributed control environments as opposed to common control systems or functionally distributed technologies. In the fully distributed control environment, a relatively small number of ports is served by a dedicated processor and memory set to represent a fully functional systems element. The Modular Switching Unit (MSU) represents typically a 48 to 56 port intelligent network environment. The key is its flexibility and reliability resultant from the distributed control design concept. It is the only stored program control switch available which does not use a central processor. Each 48-port cell in a system has its own microprocessor control, communicating with the other cells via a data bus. As a result, a 48-port cell can function as a complete system by itself or can be plug connected to other identical cells to make a 384-port maximum size system. Each cell configures itself to assume its proper place in the numbering plan when connected to the adjacent cell. The equipment is mechanically configured to fit in a standard EIA 19-inch rack. As a result, it can be fitted into a wide variety of off-the-shelf standard cabinets depending on system size. A user can stock cells and several cabinets and make up various sized systems, as required. There are only five different type cards in the system's control, which results in feasible maintenance by card substitution. The MSU is a very reliable and powerful system and it allows 36 CCS of traffic per port. The "Family of Products" approach allows applications of most of the hardware to many applications such as business systems, central offices, special feature nodes and ISDN trials.

It is recognized that the repeated implementation of complete control with every block of ports constitutes an increased cost factor for larger sized systems. However, the benefits far outweigh the penalties of future purchases. While common control systems, regardless of their sophistication in redundancy, will still experience a decrease in meantime between catastrophic failures (MTBFc) with size, the opposite is true in fully distributed systems. The more sub-groups in use, the less likely the occurrence of an all-out failure. In a fully distributed control there is no common controlling element aside from a hard-wired bus. What you don't have can't fail. (Fig. 1)

Redcom's exchanges have been applied worldwide to the rural areas, that is smaller population size, and performance has been excellent. It is obvious that there have been and will be failures of components. The meantime between failures (MTBF) is a statistically arrived number. The design therefore incorporates a relatively low number of circuit types and service is performed by replacement of those circuit boards. Of course statistics can be defined as putting your head in the freezer, your feet in the fire, and feeling very comfortable on the average.

Redcom's systems do not employ discrete wires within the subset of a 48-port shelf. Consequently, no failure diagnostics need to be performed between circuits, eliminating the old-fashioned requirement of putting boards on extenders and trouble-shooting failures through applications of oscilloscopes or other

Reliability-Control Concepts

Packaging for Emergency Use

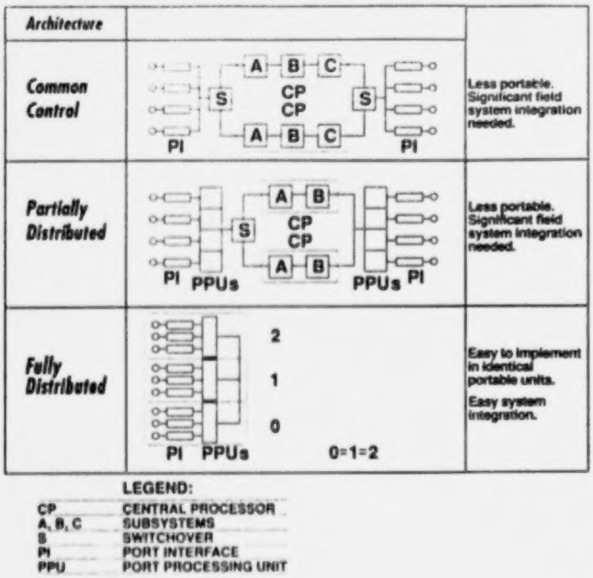
Architecture
Common Control
PI
S
A
B
C
CP
CP
A
B
C
S
PI
Less portable. Significant field system integration needed.
Partially Distributed
PI
PPUs
S
A
B
CP
CP
A
B
PPUs
PI
Less portable. Significant field system integration needed.
Fully Distributed
2
1
0
PI
PPUs
0=1=2
Easy to implement in identical portable units.
Easy system integration.
LEGEND:
CP CENTRAL PROCESSOR
A, B, C SUBSYSTEMS
S SWITCHOVER
PI PORT INTERFACE
PPU PORT PROCESSING UNIT

Figure 1

sophisticated test equipment. Because of simplicity of installation and maintenance. these systems are ideal for small and remotely populated areas. Operating companies in those areas have great difficulty attracting appropriate technological talent to maintain the usual technologically advanced equipment. And should they be so lucky, there is the unfortunate possibility that they will lose that talent within a short time. Simple to use systems which take a week or two for technical training offer great advantages over the customary six-month effort. Redcom's Central Offices have therefore been ideal for the environment in Alaska, the Yukon and Northwest Territorial areas, as well as in the eastern part of Canada and the South Pacific. (Photo 1) PABX versions of the technology are widely used in the jungles of South America, the Philippines, and China. NTT in Japan most recently started purchasing Redcom's Central Offices as emergency standby systems for their larger installations, as several of the Bell companies have done.

Large systems do not die gracefully and sometimes take an unacceptable amount of time to restore to service. During that phase Redcom's MDX can provide service to emergency facilities such as hospitals, fire departments, police departments and some public phones.

These systems are ideally suited for a wide variety of environmental conditions. Their operating conditions allow for a temperature of 50° C ambient without fans or air conditioning. In many countries primary power is so unreliable that unless an air conditioner for an office is run off the primary office batteries the general systems could not function in spite of having adequate battery backup. That drastically reduces the standby capacity.

Currently about 40% of the installed systems in Alaska are Redcom's MDXs. Many of the systems, although small, serve population pockets poised for growth. In those areas it is quite difficult to determine beforehand what the growth will be. Sometimes emergency situations require significant instant growth, such as the recent oil spill in Alaska which prompted a large influx of press, emergency crews, and sightseers. For example, Chenega Bay needed to increase its system dramatically within a matter of days. Redcom's technology allows that to happen. Within days the office was expanded.

The current MDX can gradually be increased from typically 48-56 ports in the same increments to approximately 10,000. At the same time the system offers, through its 10K technology, the future application of ISDN and SS7. It is a matter of economics when and where those attributes will be added.

The application of an Expanded Switching Unit (XSU) complements the distributed control architecture. The MDX stack and the XSU are interconnected by an MSU Gateway Board (MGB). The MGB is inserted in an XSU backplane in any general purpose board position, where it becomes a member of a domain. It also is cabled into an MDX stack as shelf zero. (Fig. 2)

Messages originating in the MDX stack are received by the MGB and, when appropriate, can be directed to any other MGB and thus any other MDX stack. This technique permits the use of the already existing and well-proven software base (and all associated features) in the MDX that will, with minimal changes, operate as a much larger system.

Distributed Control Architecture Of MDX-10K

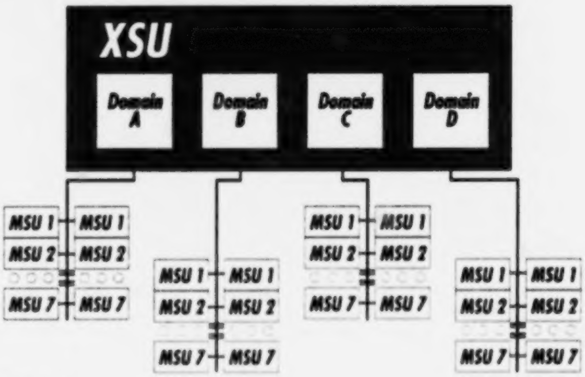
XSU
Domain A
Domain B
Domain C
Domain D
MSU 1
MSU 1
MSU 2
MSU 2
MSU 7
MSU 7
MSU 1
MSU 1
MSU 2
MSU 2
MSU 7
MSU 7
MSU 1
MSU 1
MSU 2
MSU 2
MSU 7
MSU 7
MSU 1
MSU 1
MSU 2
MSU 2
MSU 7
MSU 7

Figure 2

Using a unique distributed architecture, two new circuits, a new shelf design, and some cable, the MDX-384 has been transformed into an MDX-10K, providing all features available in the MDX-384 but with a capacity of approximately 10,000 ports.

The addition of appropriate interface circuits and control software will allow the MDX product to dramatically increase port capacity. Also, the newer telephone network capabilities can be added by the design of individual circuits and the addition of control software. ISDN capabilities are readily added. Due to the availability of both 64 kb voice data paths required by ISDN standards and an underlying network for potential packet messages that may be sent on the ISDN "D" channel, interfaces such as SS7 can be added by the design of an appropriate interface. Since each circuit board that is designed for the new system will have an on-board processor, new circuits, such as an SS7 interface, can be designed with sufficient intelligence and power at the interface to solve any real-time protocol problems.

In regions with a dispersed population, systems are not always interconnected to the network via cable or direct transmission facilities. Quite often microwave links or satellite facilities are applied. Many of Redcom's MDXs in the northern region of North America, for example, are earth station based and use satellite links to connect to the network in Anchorage. Generally, those offices use standard North American E&M Signalling, however, with a very slow wink timing. Most recently Signalling System 5 has been added which is primarily used for interconnection via satellite of INTELSAT 4 type which links the network to Europe. The earth station of Washington International Teleport in Virginia is being interfaced directly to Italy via INTELSAT 4 with a small tandem MDX using Signalling System 5 trunks. A similar installation is planned for the Cook Islands to link the island of Aitutaki with the rest of the nation while at the same time serving its local subscribers. It is quite obvious that at the same time IDDD can be offered directly. (Fig. 3)

SUITABILITY FOR EMERGENCY PREPAREDNESS

Although it is well known that disasters and emergencies are difficult to schedule we invariably see a struggle for suitable equipment once an emergency case has occurred. The recent earthquakes and hurricanes are no exceptions. As far as telephone systems are concerned certain criteria require more attention than others:

> There are disaster type emergencies such as floods, earthquakes, hurricanes, land-slides, explosions, etc.
>
> There are also emergencies due to technical failures; i.e., out of service for the main switching area and power failures.

In the first instance telephone communications will most likely encompass command control type functions, and portability is mandatory. In the second instance communications is merely a standby operation for critical subscribers, and portable packaging, although desirable, is not that critical. The command control type services are probably best provided through PABX type implementations with key per circuit consoles and hotline circuits. (Photo 2) General emergencies can be handled by CO-type equipment. Generally, police, hospitals, doctors, fire departments and some pay phones for the general public use will provide needed emergency service if the area's main CO network interface is inoperable. A system can either be spliced into the area's overhead cables or underground manholes and the database configured to provide for proper dialing codes to accommodate the network. If no access is available, a small microwave link into a non-devastated area might provide the access.

Central Office Connectivity

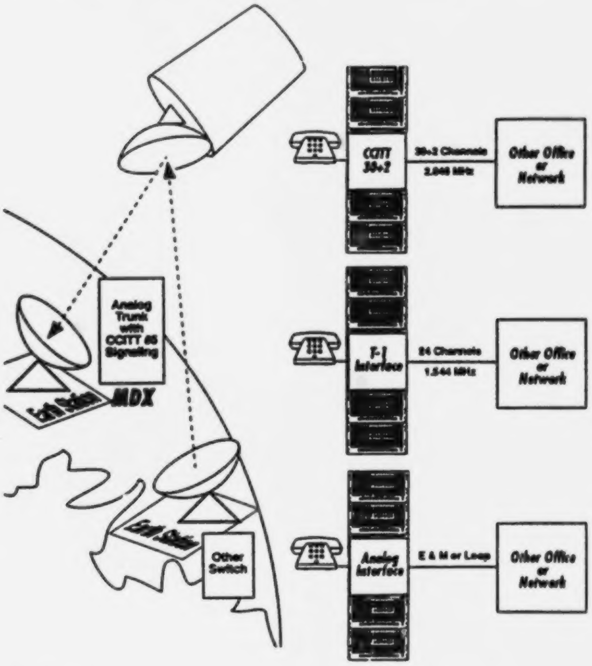

Figure 3

Because of the foregoing, it is extremely important that the emergency system can be reconfigured and easily adapted with its numbering plan to accommodate the network and allow various types of hardware to accommodate the available access to the network.

With the help of ADBAR®, Redcom has been able to provide different database configurations which can be downloaded into the emergency system. To function properly emergency systems must be complete; that is, mainframe and connector block integrated into each unit. 25-pair cable arrangements with standard modular phone jack drop-offs can be used to quickly distribute wire pairs to operators who need access to the phone.

We should not overlook the importance of cellular mobile phones to assist in emergencies. However, most of them depend on a CO-type switch. In the California earthquake that did not help very much.

Redcom's MSU based system in its shock absorbent container (Photo 3) offers the hand portable early type emergency assistance. It can easily be set up in a tent or other suitable enclosure and powered by a small portable generator. It does not help very much to have big truck driveable containers available when the area is devastated through road destruction, flooding or land slides. I think it would be wise to plan for possible emergencies ahead of time. Response time may save lives and property.

This type of emergency system is also well suited for temporary service in a developing area which can then be easily replaced when all trends and projections are known.

Last, but not least, the inherent reliability in the architecture of the system's design is of utmost importance for emergency operations.

THE ADJUNCT SOLUTION

With all the new attributes and facilities required in the not too distant future, many operating companies would face a significant equipment replacement program. Not all equipment is easy to update and to adapt. Furthermore, a lot of equipment is not depreciated enough and tariffs are at a level unfavorable to finance replacement. An adjunct or feature node may be the answer to extend the usefulness of the existing equipment.

The development of the Modular Switching Peripheral (MSP), which offers the utmost flexibility through host computer programming, is a viable answer. An MSP typically contains from one to eight Modular Switching Units and uses many of the same control and port cards. Commands and responses between the MSP and the host are sent via an RS-232c link (multiple links are possible, facilitating fail-soft host/MSP architectures). The RS-232c links operate under a fault detecting and recovery protocol for a response from the MSP to the host. The same procedure, in reverse, is used to send a command from the host to the MSP.

Almost every Bell Regional Holding Company and AT&T have MSPs in various applications in their networks. In addition to the preceding examples, many other applications are possible with the MSP including:

- Feature prototyping to determine the marketability of new features before committing to adding them in embedded switching equipment with large installed bases.

- Special service node applications such as screening for 800 numbers or automated third party billing services with automatic operators.

- ISDN experimentation through use of digital interfacing circuitry such as Redcom's 64 kbps Synchronous Data Port.

This may be a relatively inexpensive way to provide, partially, for special services. An added advantage is the shared printed wiring board complement with all other Redcom products. As an example, the Modular Integrated Communications Environment, MICE, is a feature prototyping system developed at Bellcore. (Fig. 4) The primary motivation for MICE is to provide a means for realistic design and evaluation of advanced communication services and user interface technologies for the public network without the expense and overhead associated with field trials. Thus, MICE is a real system, providing reliable communications services to a community of friendly users, but permitting convenient experimental control over services and interfaces (4.)

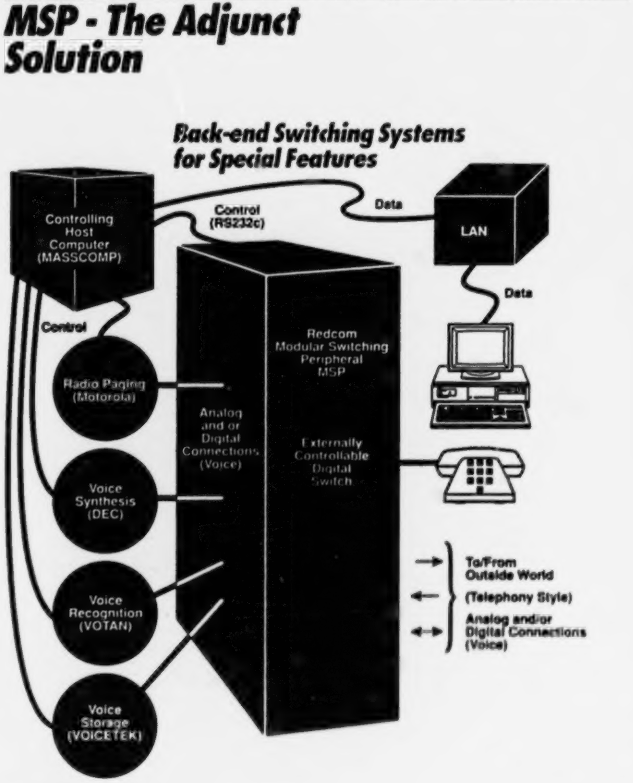
MSP - The Adjunct Solution
Back-end Switching Systems for Special Features
Controlling Host Computer (MASSCOMP)
Control (RS232c)
Data
LAN
Data
Control
Redcom Modular Switching Peripheral MSP
Radio Paging (Motorola)
Analog and or Digital Connections (Voice)
Externally Controllable Digital Switch
Voice Synthesis (DEC)
Voice Recognition (VOTAN)
Voice Storage (VOICETEK)
To/From Outside World
(Telephony Style)
Analog and/or Digital Connections (Voice)

Figure 4

CONCLUSION

The system's range, sophistication and technical windows to apply new technological attributes, coupled with the simplicity of use in the operating environment makes the system an ideal solution for the rural market.

There is absolutely no reason why a rural subscriber cannot enjoy all of the sophistication available through today's integrated networks at an affordable price. I indicated before that the systems' technology would tend to grow more expensive as it grew in size. However there are also offsetting factors of economy of scale. As a manufacturer can construct systems of larger sizes which consist of the same building block over and over again, appropriate volume discounts can apply bending the cost per line curve in favor of the buyer.

We are constantly monitoring actual performance parameters against the projected ones based on the statistical meantime between failures. I am happy to say that the actual data is even better than the already favorable theoretical one. Redcom has not needed to supply field service, but has a 24 hour call-in facility available to assist in problem solving. We are continuing to devote 30% of our company business to product maintenance and enhancement to assure a minimum of obsolescence and a maximum of value invested by the buyer.

New technological advances always are at the horizon. But the systems business is usually component driven and needs to await component maturity. Currently at 64 kb bandwidth circuit switches with 144 kb for ISDN are state of the art. Wideband switches may well be the technology of the future.

This system's architecture and its packaging techniques have made it very suitable to be applicable in many environments by sharing essentially the same hardware and ease of switching from one service application to another.

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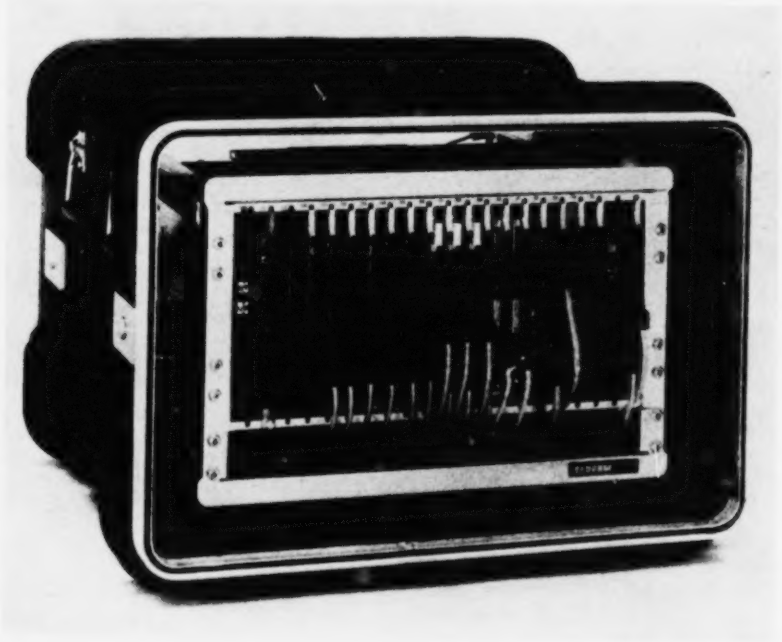
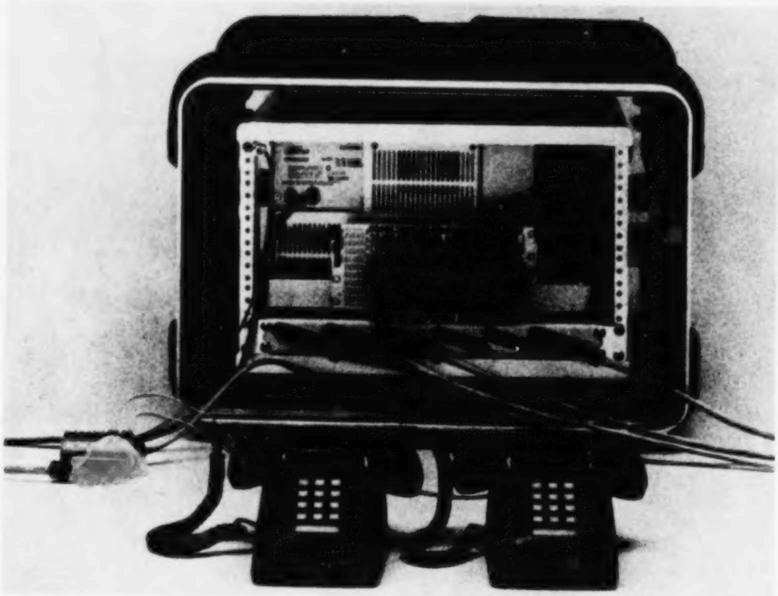
Central Office Building at Ofu
American Samoa

Redcom's Portable Emergency Dispatch System

Photo 2



Front View



Back View

Portable MDX in shock-proof container - ready for emergency service

Photo 3

FACILITATING THE GROWTH OF INTERNATIONAL EMERGENCY MEDICAL ASSISTANCE VIA SATELLITE

John C. Scott and Jerry Freibaum
The Public Service Satellite Consortium
Washington, D.C.

Under the auspices of the US/USSR Joint Working Group on Space Biology and Medicine, NASA funded and implemented a "Telemedicine Spacebridge" which provided satellite video, voice, fax and telex links between Soviet and US medical teams for treatment of Armenian earthquake victims. The "Spacebridge" was highly successful and participants recommended that the medical spacebridge concept be continued and expanded on a worldwide basis. However, the effective implementation of these kinds of emergency medical links, on a worldwide basis within hours of the onset of a disaster, requires international agreements for the entry and operations of relief teams as well as their communications and rescue equipment.

This past summer, NASA's Communications and Life Sciences divisions initiated a four-month "Telemedicine Spacebridge" experiment between the Soviet Union and the United States to provide long-distance medical assistance, via satellite, to earthquake-stricken Armenia. It was conducted through the US/USSR Joint Working Group on Space Biology and Medicine.

Initial satellite communications links consisted of one-way video, two-way audio, data, fax and telex. It was the product of a cooperative effort on the part of the COMSAT Corporation, INTELSAT, AT&T, Satellite Transmission and Reception Specialists and NASA's Goddard Space Flight Center in the US, and the Soviet Ministry of Post and Telecommunications.

The earthquake, which occurred early December 1988, caused more than 150,000 casualties as well as widespread destruction estimated at $20 billion to $40 billion.

The US physicians and specialists that participated in the spacebridge project provided consultative support to more than 200 Soviet physicians primarily, in the areas of reconstructive surgery, rehabilitation and psychiatric care for post-traumatic stress disorder. Participating US centers were: (1) The Uniformed Services University of the Health Sciences in Bethesda, (2) The University of Maryland Institute of Emergency Medical Services Systems, Baltimore, (3) The University of Texas Health Science Center, Houston, (4) LDS Hospital and The University of Utah, Salt Lake City.

The Public Service Satellite Consortium (PSSC) provided telecommunications applications support to NASA and the USSR Ministry of Health during this project. In June, while in the Soviet Union working on an extension of the US/USSR spacebridge, John Scott, Director of International Programs and Disaster Communications for PSSC and Jerry Freibaum, a PSSC senior consultant, were met with an urgent request from the Soviet Ministry of Health to provide technical assistance to medical experts treating victims of a gas explosion near the city of Ufa in the Ural region of the Soviet Union. Twelve hundred casualties resulted when sparks from a passenger train ignited gas escaping from a ruptured line nearby.

In response to this request, NASA extended the Armenian spacebridge project to include black-and-white slow scan video and voice communications between Ufa and Yerevan for retransmission through the spacebridge to the United States where the same hospitals provided medical consultation to burn specialists in Ufa. This equipment was used because it quickly established simple-to-operate links using existing terrestrial voice circuits and infrastructure not capable of accommodating full-motion video. It enabled transmissions of photo images of the burn victims, taken by Soviet physicians, as well as audio teleconferencing.

The quick response to this request was made possible by an intensive coordinated effort by SOYUZMEDINFORM, a division of the Soviet Ministry of Health, and the Ministry of Posts and Telecommunications. The slow scan video transceivers were donated by Colorado Video, Inc. of Boulder, Colorado at PSSC's request.

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An important outgrowth of this program has been increased awareness among medical, technical and political institutions of the application of satellite communications to disaster medicine. Several participants, including PSSC, are involved in proposals to continue and expand the spacebridge concept on a worldwide basis.

However, there are access problems that must be addressed for this expansion to occur. Proposals are being developed to establish international agreements that would include provisions for frequency assignments as well as entry and operations of relief teams and their communications and rescue equipment into foreign countries for disaster relief.

Large segments of the world are vulnerable to rapid-onset disasters and survivable and affordable communications will soon be available to most of these areas during the critical early phase of a disaster.

One of these systems, mobile communications via satellite, offers low-cost, two-way voice and data communications to areas previously considered impractical or impossible to cover because of their location, terrain, weather or demography. These services will complement and greatly enhance existing cellular mobile and fixed terrestrial communications services.

Worldwide use of mobile satellite technology should dramatically improve hazard prediction, risk assessment, disaster preparedness, early warning, onset and post-disaster relief operations.

The United States, other countries, and regional and international organizations have either initiated or indicated their intention to provide mobile satellite services.

However, without international agreements providing for the entry and operations of relief teams and their communications and rescue equipment in foreign countries the effectiveness of telecommunications systems for disaster mitigation will be greatly reduced.

The following is PSSC's draft recommendation for agreements to facilitate entry and operations of relief teams and their communications and rescue equipment in foreign countries for disaster relief. It is one of the outcomes of the US/USSR spacebridge project and recommendations made during the Symposium on Disaster Communications conducted in April 1989 by PSSC, sponsored by the American Mobile Satellite Corporation, COMSAT, GEOSTAR, INMARSAT, McCaw Cellular, NASA and QUALCOMM, Inc., and hosted by the State of California.

Representatives from federal, state and local agencies, U.S. industry, universities, the American Red Cross and the United Nations participated in this symposium.

-- DRAFT RECOMMENDATION --

AGREEMENTS FOR THE ENTRY AND OPERATIONS OF RELIEF TEAMS AND THEIR COMMUNICATIONS AND RESCUE EQUIPMENT INTO FOREIGN COUNTRIES FOR DISASTER RELIEF*

(In support of The International Decade for Natural Disaster Reduction)

RECOGNIZING

(a) that the natural hazards of earthquakes, tsunamis, volcanos, floods, hurricanes, typhoons, tornadoes, landslides and wildfires have caused great loss of life, enormous property damage and untold suffering throughout the world;

(b) that the risk from natural hazards continues to increase due to rapid population growth and its increasing concentration in urban areas, increasing capital investment projects worldwide, the interdependence of people in local, national and global communities, and the existence of large numbers of unsafe buildings, vulnerable critical facilities and fragile lifeline systems;

(c) that high casualties and property loss resulting from catastrophic disasters are often blamed on lack of preparedness and early warning or inadequate and inefficient relief operations;

(d) that despite its obvious critical need, communications is almost always disabled during the first several hours of a major disaster;

(e) that satellite communications and remote sensing technology can play major roles in reducing the devastating effects of natural disasters by dramatically improving hazard and risk assessment, disaster preparedness, early warning and onset, and post-disaster relief operations;

(f) that the benefits of these technologies are often not realized during the critical onset phase of a disaster because of the absence of international agreements on frequencies and the entry and operations of relief teams and their communications equipment;

(g) that on December 11, 1987, the General Assembly of the United Nations established an International Decade for Natural Disaster Reduction beginning in 1990;

(h) that the goal of the International Decade for Natural Disaster Reduction is to promote cooperative efforts between nations to reduce the ravages of all types of natural hazards through the international exchange of data, the identification of gaps in knowledge, cooperative research projects, implementation of mitigation measures, preparedness planning and hazard awareness and the timely and effective transfer of information and knowledge;

(i) that individual countries, including the United States, have declared national decades consistent with the International Decade for Natural Disaster Reduction;

(j) that the International Decade for Natural Disaster Reduction requires the cooperation of all nations to successfully meet its goal;

CONSIDERING

that we are now at the threshold of being able to universally apply advanced satellite communications and remote sensing technologies to rapid onset disasters as well as long-term hazards such as drought and desertification, and man-made hazards such as ozone layer depletion and hazardous material transfer;

RECOMMENDS

(1) that the Office of Foreign Disaster Assistance (OFDA), in conjunction with the Office of the United Nations Disaster Relief Coordinator (UNDRO), develop international agreements for mutual disaster assistance and that these documents be submitted to the International Telecommunication Union (ITU) for ratification;

(2) that these agreements should include provisions for facilitating frequency assignments and entry and operations of relief teams and their communications and rescue equipment into foreign countries for disaster relief;

(3) that all nations act to encourage the integration of new communications satellite and remote sensing technologies into disaster mitigation initiatives.

* Since preparations for a 1992 international telecommunications conference are underway, PSSC has taken preliminary steps to introduce this draft recommendation into the process for consideration as a U.S. position.

PSSC is a non-profit organization with more than 100 members representing large and diverse segments of the educational, medical and emergency response communities. It devotes significant attention to the application of communications technologies for disaster mitigation. PSSC's experience dates back to the early 1970s, being one of the early pioneers in the use of satellite telecommunications for public service applications.

For more information about the proposed agreements or PSSC and its programs, please call or write John Scott, Director of International Programs and Disaster Communications, PSSC, 600 Maryland Avenue, SW, Washington, DC 20024, 202-863-0890.

Session 5.6

Telecommunications and the Travel Industry Panel Discussion

NOTES

Session 6.1

Distance Learning - Technology and Techniques II

NOTES

Classroom Tutorials by 64 kbps Videoconferencing

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1. ABSTRACT

Classroom tutorials were transmitted experimentally by 64 kbps videoconferencing and ISDN. An initial evaluation of the system by student was generally positive. Quality of voice in technology, and also method of interactive teaching or presentation of teaching materials in pedagogy were quite important for the purpose of substitution for face-to-face tutorials.

2. INTRODUCTION

The present work was concerned to a joint research project in cooperation with Kokusai Denshin Denwa Co., Limited(KDD), Japan and VIDEOCOM International Corp., Japan carried out in 1988. There were following three issues as background of the project.

2.1 ISDN

NTT(Nippon Telephone & Telegram) began to service Information Network System by 64 kbps(INSNET64) from April 1988. The system was cost-effective, being able to use traditional telephone lines.

2.2 INVITE64

The new 64 kbps integrated visual telecommunication system(INVITE64) was invented by KDD in 1986. The system made it possible to transmit compressed motion video, audio, still picture, facsimile or data by the use of 64 kbps digital line(1). It took initiative in the videoconferencing system via low bit rate digital network and succeeded in international trials of interactive live conference.

2.3 THE UNIVERSITY OF THE AIR(UA)

Developing the technical system and pedagogical method for tutorial at a distance, as a possible substitution for face-to-face tutorial has been considered as one of the most important problems to be solved at the University in preparation for its projected nationwide expansion. From this standpoint, we reported recently on experimental teaching at a distance through teleconferencing using electronic black board and slow scan TV(2). Motion picture was considered desirable to provide to overcome the sense of artificiality in the experiment.

3. ORGANIZING THE SYSTEM

At the beginning of the present work, it was noticed that INVITE64 was developed for the purpose of so-called TV telephone or TV conferencing rather than educational use. It was necessary to extend its functions to fit the new educational application. For example, a video camera focusing to face should be moved to the back of the classroom to keep eye contact with the student at a distance, also, a camera focused to the materials on tutor's desk had to be fixed at the ceiling directly overhead of the tutor. On the other hand, at the receiving site, depending on the size of classroom large sized TV visible to all students was installed. Alternatively, a number of small TV had to be dispersed throughout classroom. In addition, microphones needed to be properly arranged, and it was desirable to provide an echo-cancellor to improve voice quality.

The research work was carried out in three steps as follows.

The first step: Fundamental research on student reaction to compressed video.

The second step: Experimental tutorial session at a study center of UA using INVITE64.

The third step: Experimental tutorial session connecting two study centers of UA via ISDN and INVITE64

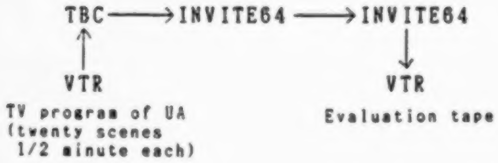
4. FUNDAMENTAL RESEARCH ON STUDENT REACTION TO COMPRESSED VIDEO

As previously mentioned, INVITE64 was originally designed to transmit information by digital compression to 64 kbps. Consequently the picture needed to be transmitted at a low frame rate of one third compared with usual TV.

This inevitably resulted in a considerable decline of the quality of the picture. First of all, we investigated student reaction to this problem. For this purpose, we prepared evaluation tape by the way showing in Figure 1.

Figure 1

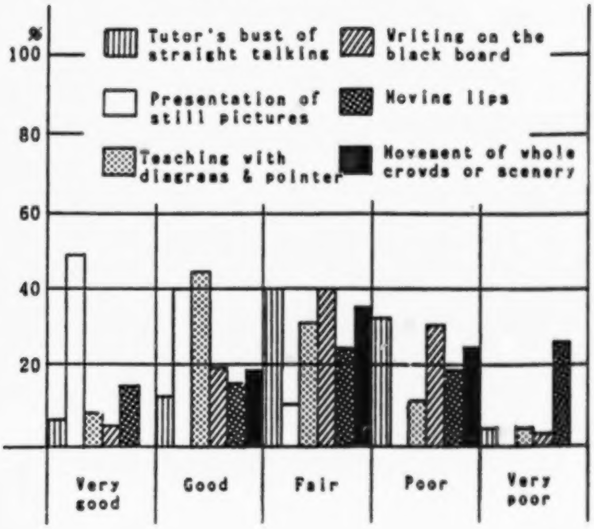
Preparation of evaluation tape



Then the tape was evaluated by volunteer students(N=22) at the Institute of International Communications, KDD. It was found that still pictures: flips, photographs, or graphics , were quite acceptable, also, tutor's bust of straight talking, teaching with diagrams & pointer or writing on the black board were fairly good acceptable than expected to the students. On the other hand, both moving lips in the training of language pronunciation and the movement of whole crowds or scenery could not be well discriminated by the students. Student's evaluation of compressed motion picture was shown in Figure 2.

Figure 2

Student's evaluation of compressed motion picture



5. EXPERIMENTAL TUTORIAL SESSION AT A STUDY CENTER OF UA USING INVITE64

Three tutorial sessions: Philosophy (Prof. H. Nakano), Earth science(Prof. N. Nasu) and Business management(Vice President Y. Kobayashi), twenty minutes each, were transmitted via INVITE64 from a class where both tutor and students attended to another class of only students in the Chiba study center. Twenty one students (seventeen inexperienced, four experienced in the system) and nineteen faculty members were attended throughout the tutorial session. Evaluation was carried out by students and faculty members questionnaires of five ranks rating the educational aspects and human factors after the whole session. These were presented in Figures 3 and 4 below.

Figure 3

Evaluation of experimental tutorial session at the Chiba study center

a) Quality of motion picture
b) Quality of voice
c) Visibility of data on TV
d) Fatigue
e) Sense of closeness to tutor

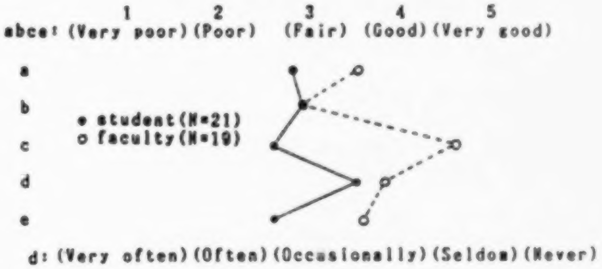
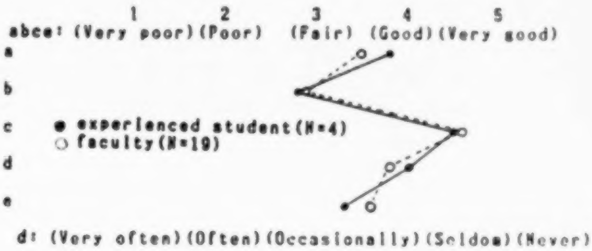


Figure 4

Evaluation of experimental tutorial session at the Chiba study center

a) Quality of motion picture
b) Quality of voice
c) Visibility of data on TV
d) Fatigue
e) Sense of closeness to tutor



It was noticed that evaluation by experienced students was quite similar to that by faculty members who were mostly familiar with the system. Getting used to the system was likely to effect evaluation of visibility, fatigue or sense of closeness to tutor.

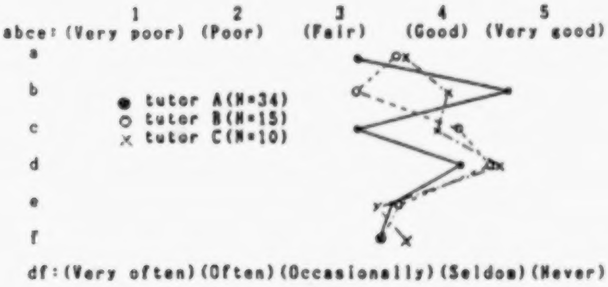
6. EXPERIMENTAL TUTORIAL SESSION CONNECTING TWO STUDY CENTERS OF UA VIA ISDN AND INVITE64

Three live tutorials, about one hour each, of Japanese literature(Associate Prof. N. Kioto), Food science(Prof. M. Miyazaki) and Earth science(Prof. N. Masu) were transmitted from the classroom of the Saitama study center where tutor attended to the classroom of the Tokyo-2 study center via INVITE64 and ISDN (INSNET64). The two classrooms were thirty kilometers apart from each other and were both attended inexperienced volunteer students. After each of the three tutorials evaluation was done by students and those faculty members who presented the tutorial using feed back form with five ranks as previously mentioned. Figure 5 gave the result of student evaluation at the Tokyo-2 study center.

Figure 5

Student's evaluation of experimental tutorial session at the Tokyo-2 study center

a) Quality of motion picture
b) Quality of voice
c) Visibility of data on TV
d) Fatigue
e) Sense of closeness to tutor
f) Sense of artificiality



Remarks: a) Tutor A moved frequently to present printed materials with still pictures. It was supposed that this caused a decline in evaluation of motion picture quality.

b) Tutor B spoke in low pitched voice which might have resulted in difficulty hearing for the entire classroom.

c) Printed materials presented by tutor A were written too small to be satisfactorily visible to all students in the classroom.

Considering the points mentioned above, it was thought that properly used tutorial at a distance was acceptable to most students during whole three hours via 64 kbps videoconferencing just like as regular face-to-face tutorial session.

7. CONCLUSION

We could summarize the present work as follows. Low bit rate videoconferencing may have possibility of practical use for teaching at a distance, particularly for an interactive small sized classroom, or a student participated session like group interviewing, seminar, learning guidance and so on. To get success in the educational use of the compressed videoconferencing, we have to pay special attention to technological and also to pedagogical matters.

Technological:

To keep good voice quality

Pedagogical:

To keep presenting still picture, writing on the black board, teaching interactively and no swinging quick motion in the course of tutorials. Training both tutor and student was thought to be quite advisable.

ACKNOWLEDGMENT

The authors wish to express special thanks to Dr. Yasuo Kobayashi, the former Vice President of the University of the Air, for his valuable suggestions and encouragement, as well as to faculty members and students also to the stuff of KDD and VIDEOCOM International Incorp. who participated in the present research project for their helpful collaborations.

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Telecommunications-Telementoring-Teletraining: Enhancing and Providing Teacher Training Programs in Early Childhood-Special Education to Educators in Rural School Districts

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Abstract

Telecommunication network innovations are having a tremendous impact on enhancing and enriching teacher training programs. Computer networks enable educators to link, via a computer, a modem and communication software, various levels of the educational spectrum. The Center of Excellence in Early Childhood Education at Winthrop College has implemented a Telecommunication-Telementoring-Teletraining Project (TTT) to enhance and deliver teacher training in the areas of early childhood and special education in rural fields of South Carolina. Note: the replication of this project has national and international implications.

Telecommunication network innovations are having a tremendous impact on enhancing and enriching teacher training programs. Computer networks enable educators to link, via a computer and a modem, various levels of the educational spectrum -- from preschool to higher education. The networks promote communication and the transmission of electronic data nationwide, as well as, worldwide. Technological advances in the area of telecommunication have assisted educators in:

- delivering teacher training programs in rural areas;
- developing and adapting instructional materials and curriculums;
- sharing information and resources, analyzation of concepts; and
- preparing students for the knowledge and skills required for the technological needs of the future.

The National Education Association, in a formal report entitled "The Report of the NEA Special Committee on Educational Technology" stated that, "Technology can contribute significantly to the improvement of educational opportunity to managing the increasing knowledge base, and to improving the quality of work life for school employees" (Goodspeed, 1989). The report also stated that the NEA committee strongly expressed the opinion that:

> Schools must focus the uses of technology, not on more routinized standardization of the learning environment but on the opportunities to enrich instructional lessons, to individualize instructional objectives for students, to extend the shift from a centralized to decentralized learning environment, and to support the teachers. . . . The use of computers should be seen as an integral part of the whole school curriculum, aiding and abetting the best instructional practices and curricula designs" (Goodspeed, 1989).

Telecommunication Impact on Education

Telecommunication advances in computer networking are demonstrating educational benefits such as reducing the cost of providing and delivering educational information and data to school districts in rural areas, increased communication between educators, enhancement of sharing instructional resources, and as a tool in advancing teacher training programs.

Examples of programs include the AgriData Network in Wyoming; the Rural Instructional Continuing Education (RICE) network hosted by the Institute for Extended Learning-Community Colleges of Spokane; REDI-NET operated by the University of Wyoming at Laramie; EduNet directed by Georgia College; and the South Carolina Governor's Remediation Initiative (GRI) at Winthrop College.

National Telecommunications Initiatives

For 1989, the Department of Education, under the Fund for Innovation in Education (FIE), will grant up to $14.7 million dollars to elementary, secondary, and preschools to support innovation (LePointe, 1989). Under this program, monies are being targeted at strengthening computer based educational projects such as the Computer-Based Instruction Program (CBIP) and Technology in Education (TIE). CBIP will receive a $4.9 million dollar competitive grant appropriation to improve computer use in the schools, starting with teacher training and followed by demonstration projects that promote statewide or nationwide applicability. In addition, TIE funds will support technology in classrooms, via media such as educational television, radio, and telecommunications networks.

South Carolina's Telecommunication Incentive

In July, 1987, the South Carolina Commission on Higher Education awarded Winthrop College a grant to support a Center of Excellence in Early Childhood Education (COE). The grant was made possible by funds from the Education Improvement Act (EIA). One of the objectives of the Center was to establish a telecommunication network to provide inservice teacher training to educators in early childhood-special education, located in rural areas in South Carolina. A telecommunication network was recommended because of the need for trained teachers in early childhood-special education. (Note: The passage of P.L. 99-457 addresses the needs of handicapped and at-risk children from birth to age five. In addition, the mandated legislation of P.L. 94-142 Education for all Handicapped Children Act, requires states to train teachers to meet the needs of educating and caring for these children.) Due to the fact South Carolina is 70 percent rural, the training of teachers teaching in rural areas is a major concern. Due to physical isolation, many rural educators find it difficult to get the educational information and guidance required in order to work with exceptional children.

The need for increasing services and training for educators in rural areas is not only an issue in South Carolina, but is also a national concern. Although rural people need continued education as much as their urban counterparts, they do not always have access to it. "States with extensive outreach centers, such as California, show rural populations pursuing postsecondary education every bit as aggressively as urban ones. Yet gaps remain--the percentage of rural adults having completed four or more years of college is nearly half that of the nation as a whole" (Spears, 1988). According to Trueblood and Flanagan (1983), "The experience of Central Pennsylvania's Keystone Central School District (KSCD) illustrated how microcomputers can help solve some of the characteristic problems of rural schools." The KSCD and Pennsylvania State University participated in a collaborative effort to use a microcomputer network to improve the school district's basic skills curriculum in mathematics and the student's and faculty's computer literacy. The major benefit the participants noted was the improvement in communication between the school district and the university. The sharing of skills and theories assisted in the development of a more worthwhile curriculum. Thus, the utilization of a telecommunication computer network enabled the university to deliver vital educational research and instructional training materials to the teachers in these remote areas.

Winthrop College-Center of Excellence in Early Childhood Education: Telecommunications-Telementoring and Teletraining Project (TTT)

The exemplary telecommunication system established by the Center of Excellence is a computer network project designed to:

- promote communication between early childhood and special education professionals in the state;

- provide teachers with access to educational data and other information pertinent to their field of study;
- assist in providing information and research regarding the integration of handicapped and high-risk preschoolers into early childhood and day care programs;
- instruct teachers in the operation of utilizing a computer modem to interact with an electronic bulletin board system;
- demonstrate the various methods in which teachers can share information and teaching practices with other educators in the state; and
- provide additional graduate level college training, known as teletraining, using the computer and the modem as the means of receiving instruction and returning assignments.

Implementation of the TTT Project:

Six school districts located in various rural areas in South Carolina and a regional Head Start Program with branches of service in five of the rural counties in the state were identified for the project. The early childhood and special education administrators, plus one early childhood teacher and one special education teacher from each district and program were selected as participants.

During the Summer of 1988, the COE conducted a needs assessment of (1) the districts' computer resources; (2) the number of children that were served in the districts; (3) the types of personnel providing services to these children; and (4) the need for training in the area of early childhood-special education.

The needs assessment determined that the COE and the rural school districts had the capability to organize a telecommunication microcomputer network. With the installation of phone lines and modems in the central office of each school district, it was possible for early childhood and special education personnel to send and receive information from their school site to the COE. In addition, the needs assessment documented that (1) although all of the administrators had access to a computer, they did not have modems nor the telecommunication software required for transmission; (2) all of the administrators lacked the skills of connecting the equipment and operating the telecommunication system; and (3) all of the teachers had at least one computer in their school building but only four of the classroom teachers had a computer in their classroom.

The needs assessment also indicated that (1) all of the school districts' personnel were curious about how telecommunications could assist them with teacher training in the area of early childhood-special education and in developing a telementoring network for their professional support; and (2) all of the school superintendents were willing to install the network in their district (each superintendent signed a letter of support which included a statement regarding his willingness to participate in the project). Therefore, with the support of the superintendents, along with the interest from the administrators and teachers, the telecommunication network was initiated. On October 12, 1988 all the participants were invited to an orientation workshop and were formally introduced to the concepts of telementoring, teletraining, and networking.

Telementoring is the process of utilizing a telecommunication network between an institution of higher education (in this case - Winthrop College) and public schools located in rural areas. The COE faculty provides support in terms of assisting the district administrators with problem solving related issues; in providing research information and training practices; and keeping them updated regarding educational opportunities, resources, services, legislation and conferences.

Teletraining is the process of training educators in their perspective fields using telecommunication technology (a computer, a modem and software) to deliver instructions to teachers in rural areas. This method provides additional training opportunities for personnel who are normally restricted, due to their location, in taking advantage of inservice and college courses. The college faculty is required to adapt the curriculum and assignments for transmission over the computer. One advantage to computer delivery of instruction is the individualized manner in which the instructors must communicate with the students.

Networking allows multiple communication and information sharing between numerous computers in a school, office, district, state, nation and the world by using phone lines, modems and telecommunication software programs.

In addition, the participants were introduced to the electronic Bulletin Board System. The electronic Bulletin Board System enables users to share and obtain information, access public domain programs, and pull resources from around the state and nation.

The COE reviewed the educational benefits of employing the network and the degree and quality of information that could be shared in order for practitioners to (1) meet the needs of all children including the handicapped and those considered to be "at-risk" from birth to age eight. In particular, the COE sought to assist these rural school educators by demonstrating how the telecommunication network could assist them in providing service and information regarding:

- the administration of early childhood-special education programs;
- child growth and development;
- the education of the handicapped, preschool screening and evaluations;
- teaching methods, strategies, and materials;
- mainstreaming of handicapped students;
- classroom management and discipline;
- intervention strategies; and working with parents.

During the months of October through December 1988, the COE staff purchased modems and telecommunication software programs for the districts. The COE contacted many computer consultants to advise and assist the staff on connecting the equipment and purchasing the required telecommunication software packages. Unfortunately, the information and guidance provided by the consultants was of limited assistance because each computer required specialized connections, cables and programs. In addition, many of the software programs recommended were not **'user friendly**.' A user-friendly program indicates that the program is easily used by the general population and the program has built-in, step-by-step directions that allow a person to use the program without complex instructions. The computer companies that the staff contacted were unable to access the software and had to seek assistance from the Apple Parent Company. In most cases, the COE staff had to adapt the various cables, software and equipment to the computers located in the school districts.

Although networks have become easier to install and operate, according to Marvin Koontz (1989), "To say that they've become completely turnkey would be an exaggeration. There are some hidden problems, and the technology is still a bit leading-edge in many respects."

Outlined below are some of the major problems the COE staff encountered in installing, connecting and implementing the telecommunication computer network:

1. The staff found that the school districts did not use the same type of computers and/or models. The type of computers varied from office to office; school to school; district to district. Therefore, the COE staff had to acquire the knowledge, skills, and programs to connect each of these computers and teach the participants how to operate their machines.
2. Over 95 percent of the network participants with access to a computer were unable to operate the computer for

telecommunication activities, and over 80 percent were not computer literate in the basic applications, operations and functions of a computer.

3. The installation of the modems posed a major problem due to the fact that the modems had to be adapted for each type of computer. For example, if one used an Apple modem with an IBM computer, special cables were required. Once an order was placed for these special cables it took from four weeks to five months to arrive.

4. To utilize the 'Bulletin Board System' (BBS) with a telecommunication project requires the use of a BBS operator. To connect a modem to interact with a bulletin board requires that the modem must be set (parities) for the same configurations as the BBS. As an example, if the modem is set to send information at a speed of 2400 and the BBS is set to receive information at 1200 then the messages will be illegible.

5. The phone lines and wiring in many of the rural communities are not geared for transmission of telecommunications activities. In order to install the modems, the phone companies had to rewire many of the offices and schools.

6. The various rural telephone companies did not have the required knowledge and skills necessary regarding telecommunications and computer phone connections. The COE had to inservice the phone companies' personnel on the installation of a computer-modem hook-up. In addition, the staff had many problems in requesting a 'lock-out' switch or 'cut-off' key mechanism to the phone lines. These switches prohibit use by others of the modem line. Many of the phone installers were unaware of this device.

7. The advanced electronic phone systems now being installed in schools (i.e. a rotary system in which the calls rotate to other phone lines) required the COE to install a dedicated line. This meant that the COE had to pay for new phone lines in addition to the monthly phone charge.

8. Additional equipment had to be purchased in order to operate the computers and modems. The COE staff was unaware that certain computers require the use of a serial card in order to use a modem. Therefore, this unanticipated expense (the minimum cost of a card averaged $125.00) caused major budget problems. The installation of the cards requires one to open up the computer. People who are computer illiterate are fearful of going inside a computer to install any type of device. Therefore, the COE staff had to receive training in installing the various types of cards in the various types of computers.

9. The telecommunication software program packages had to be specialized for each type of computer and model. The software programs for Apple computers change from model to model. The software for IBM computers did not always function on the IBM clone computers. The staff continues to encounter problems using telecommunication software for the Apple IIGS model.

10. Participants needed training on using the computer, understanding the operations of telecommunications; and training on the use of the bulletin board system. This preservice and inservice training amounted to six months of group instruction, individualized instruction, and on-site follow up visitation.

11. The staff had to be on-call to travel to the rural districts to assist them in repairing and/or analyzing their computer problems and breakdowns.

12. The COE staff needed continuous training in all aspects of operating, installing, purchasing, inservicing telecommunication equipment, software

and operations. This required a great deal of manpower and funds to train the personnel.

Accomplishments of Phase One of the Project (1988-89)

Phase One began on January 16, 1989 and was concluded on June 30, 1989. The staff achieved the following:

- Early childhood-special education training information (current research studies, program methodologies, etc.) was transmitted to six school districts and the Head Start Program.
- A graduate course in Teletraining: Utilizing Computers in Training Early Childhood-Special Educators was offered during the Spring of 1989. The teachers completed the majority of their assignments from their school district by utilizing the district's computer and the modem that was provided by Winthrop College. Twenty-three educators from various rural districts satisfactorily completed three credit hours of graduate work. In addition, twelve other rural school personnel received inservice training regarding the operations of a telecommunication program.
- The district school personnel assisted the COE and the South Carolina Commission on Higher Education in identifying the issues, problems, and advantages of operating a computer-based training network to teachers located in rural areas.

Implementation of Phase Two (1989-90)

The COE is presently implementing Phase Two of the telecommunication computer network. The goals and objectives consist of the following:

- To continue the delivery of inservice training to educators in rural areas;
- To offer a second graduate teletraining early childhood-special education course to the teachers in the rural areas;
- To provide inservice telecommunications training to a selected number of elementary school principals;
- To connect a modem to the computer located in teachers' classrooms (those who participated in Phase One of the project) so that they can communicate and telement with the COE faculty from their classroom; and
- To research the effectiveness of the computer network in terms of teacher training, teacher performance, and classroom instructions.

Award of the Federal Special Project (Personnel Preparation Initiative) Five Year Grant:

In October, 1989, Winthrop College received a grant to continue the implementation of the Telecommunication-Telementoring and Teletraining Project from the Department of Education's Personnel Preparation Special Project Grant. The purpose of this grant is to develop, refine and offer a series of specialized educational programs for personnel from education and related service disciplines to work with handicapped young children and their families. Specialized coursework will be offered in rural communities throughout South Carolina on an inservice training basis. This grant will allow twenty-eight school districts to participate in the telecommunications-telementoring and teletraining activities.

Assessment and Evaluation of Telecommunication:

Mary Alice White (1989), professor of psychology and director of the Electronic Learning Laboratory at Teachers College, Columbia University, explored the educational value of technologies in our schools. She listed four questions that educators should explore in utilizing technology:

1. What is the educational value?

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2. What type of information is best presented through which medium?

3. How will we get more tools for education that combine quality technology with quality education?

4. What are the critical tools for education?

White's premise is that in order to incorporate educational and technological innovations, a thorough plan and assessment of the usage, cost, and benefits must be examined.

Gail Marshall suggests nineteen questions regarding the evaluation of computer assisted programs. The following five questions apply to telecommunication networks:

a. Does the computer project have long-range value? Does it look ahead to the next five years?

b. Were all the 'stakeholders' (teachers, principals, curriculum and staff development experts, parents, and students) involved in the planning process and in the evaluation process?

c. Is there a systematic plan for involving all teachers in computer training?

d. Do researchers know how to judge the difference between what they hope will happen as the result of computer use and what actually happens?

e. Do teachers have access to the resources they need to use computers successfully?" (Marshall, 1988)

In the Summer of 1989 the COE contracted with an outside evaluator to assess the impact of the telecommunications-telementoring and teletraining activities. Using a variety of quantitative and qualitative devices, the evaluator monitors the operations of the telecommunication network and the use of the network information by participants and how their attitudes, behaviors, and skills have changed over time. The assessment framework includes the following procedures: (1) interviews with key administrators; (2) document analysis; (3) utilization log; (4) survey of participants and supervisors; and (5) selected interviews with teachers and supervisors. The in-depth interviews may also explore issues such as the relationship of the telementoring project to other formal education and inservice programs and projects.

Educational Benefits:

The promise of telecommunications has become a reality in some states. Technology linking universities with rural schools offers inservice training for teachers as well as enriching the curricula offerings available to rural students. However, the first question educators should ask of any technological development is: "What are the educational benefits?" (Spears, 1988). Far too often the emphasis is placed on the rapid development of technology rather than on educational value.

The COE staff addressed the issues of the educational benefits of telecommunication training for teachers. The following benefits and services were identified during the implementation of the COE Telementoring and Teletraining activities:

1. Delivery of Services to Rural School Districts

A telecommunication network for rural school districts may be a cost effective way of ensuring that the needs of rural school educators are met by institutions of higher education. Several of the problems typically associated with the efforts to deliver higher education to rural areas include travel to the various districts; not enough students for the class to cover the cost of the instructor; lack of qualified instructors in the various rural areas; allowing release time for teachers to attend class; and maintenance of quality standards.

2. Increase in Technological Expertise and Skills

It has been estimated that less than 15 percent of all American teachers use technology to any significant degree (Goodspeed, 1989). One of the main concerns voiced by the COE project participants was their lack of 'technological expertise.' Most of the teachers had little or no experience with computers and several openly expressed the fear that they would be unable to master the steps involved in telementoring. It quickly became apparent that in addition to the class meetings that were convened on campus, individualized on-site instructions had to be provided. This approach proved most successful. At the end of the course, students no longer displayed a lack of confidence regarding the use of the computer. In fact, twelve of the students enrolled in Phase One requested and signed up for a continuing course that would teach them additional telecommunication skills.

3. Increased Communication Between Educators

Another benefit of the project was the increase in communication between educators. At the beginning of the project it was apparent that the participants had little or no contact with each other although all were involved in early childhood education or special education. The teachers were acquainted with the other teachers in their schools and with the supervisors in their district; however, they had little or no time to meet and share ideas. Utilizing the bulletin board allowed the teachers to send ideas, lessons, reports, and printed materials to each other. Also, telecommunications provided the opportunity for teachers to share resources with other teachers located outside of their county. The same degree of 'lack of communication' existed for the school administrators, even though they attended many of the same professional meetings. One of the first telementoring assignments of the teletraining class was to send an electronic mail message, via the computer, to another colleague. At the end of the course the students were well acquainted and a real spirit of comradery existed.

4. Increase Communication Between School Districts

In addition to the increase in communication between educators in a school district, there was also an increase in communication and sharing of resources between school districts. District supervisors of early childhood education and special education used the electronic bulletin board to make announcements and share information of interest with the network. The teachers also crossed district lines to ask for help and to give support to each other.

5. Enhancement of Formal Teacher Training

The establishment of the Telecommunication-Telementoring-Teletraining Computer Network provided two-way communication between Winthrop faculty members and educators in the rural districts. The COE staff transmitted research news, curricula instructions and teacher training materials to the participants. A series of mandates and suggestions were also shared with the educators. The teachers attended other conferences and seminars to augment the information that they received from the computer.

6. Enhancement of Informal Teacher Training

As the educators grew more skilled and more confident of their ability to communicate with each other via the network, the length of the messages exchanged dramatically increased. Teachers and administrators were able to ask and receive help from each other as well as from the Winthrop College faculty regarding their efforts to mainstream children into their classrooms. The telementoring network offered participants a support system which was heretofore nonexistent.

7. Awareness of Statewide Efforts

The teachers also became aware of the state's efforts to implement various educational policies, procedures, projects and activities. It is often difficult for rural school districts to keep abreast of statewide initiatives and policies -- but through the use of the electronic bulletin board current statewide information and changes were posted.

Unanticipated Benefits

Unanticipated educational benefits included the following;

(1) Some teachers purchased computers and/or attached a modem to their home computer. This allowed them access to the bulletin board twenty-four hours per day, seven day a week.

(2) All of the teachers became advocates for incorporating technology into the school curriculum.

(3) Many teachers shared their telecommunication experiences with other teachers, and there have been numerous requests to repeat Teletraining Phase One for the Spring semester of 1990.

(4) Many of the teachers taught their students how to operate the computer and to participate in the telementoring.

(5) The teachers requested a followed up telecommunication class to learn additional skills such as downloading, uploading, and using public domain programs and archives.

(6) The teachers expressed an interest in telementing with other teachers in early childhood-special education outside of South Carolina.

(7) Two superintendents requested that the Telecommunication-Telementoring and Teletraining Program incorporate subject areas other than early childhood/special education.

(8) Three of the school districts have established an internal school network system thereby connecting all of their schools by computers.

Telecommunication technology undoubtedly has major educational implications. The Department of Education has proposed an Office of Technology Transfer authorized under the 1988 Omnibus Trade Bill to " . . . provide legislative authority to monitor education technology initiatives across the federal spectrum, tracking developments that could be useful for schools" (Knauth, 1989). The Winthrop College-Center of Excellence in Early Childhood Education's Telecommunication-Telementoring and Teletraining Project has demonstrated, and will continue to demonstrate for the next five years, ways in which telecommunications can assist educators in enhancing teacher training programs and in enriching all areas of the educational spectrum.

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LONG DISTANCE TEACHING THROUGH PALAPA SATELLITE
The Prospect of Secondary Level Teaching of Appropriate Technology in the Eastern Part of Indonesia

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1. ABSTRACT

Long distance teaching by means of the "Palapa" Satellite is helping to educate university students in the eastern islands of Indonesia. Following the launching of the Palapa A-1 satellite in 1976, the Rural Satellite Program in 1981 began to search for an appropriate method of utilizing it for educational purposes. SISDIKSAT, an Indonesian acronym for Satellite Education System, is the organizational body responsible for this program which was set up by the Eastern Islands Universities Association. Up to the present, the satellite long distance teaching program is considered to be a success with respect to both technical maintenance and the teaching program.

The main goal of the government's development program is to enhance the quality of life of the people, primarily those who live in the rural area. In line with this goal, the Rural and Area Development Study Center, attached to the Research Institute of Hasanuddin University, hopes to make use of the satellite facilities for teaching "appropriate technology" to secondary level education to rural students. A political will from the government is necessary, but a greater need exists for an indepth study on the technological/economic feasibility of such a project. All efforts will bear fruit only in an atmosphere of open discussion, and with support from an international professional body.

2. INTRODUCTION

This paper was to be presented during the tenth annual conference of the Pacific Telecommunication Council (PTC), 1988, in Honolulu. At that time I held the position of director of the Rural and Area Development Study Center, a unit within the Research Institute of the University of Hasanuddin. Despite moving to a new position as secretary of the Research Institute, I continue to take an interest in the subject of this paper, and believe it merits attention at this time by this Body.

As the director of the Rural and Area Development Study Center, I was aware of the fact that the people in rural area, primarily those in the eastern part of Indonesia, require more attention in the effort to increase their income. We really need a tangible action to free them from poverty inprisonment. And there are so many ways to do it. The best way is to help them by enhancing their capability to better their own life. This can be done by introducing more appropriate technological methods into their traditional life. This is the goal of the Rural and Area Development Study Center (a center under the Research Institute of Hasanuddin University) as it makes use of the facilities provided by Indonesia's Satellite Education System, whose regional center for eastern Indonesia is located at Hasanuddin University in Ujung Pandang, South Sulawesi Province.

3. SISDIKSAT

Indonesia with its large population is now facing a number of challenges that require innovative responses, primarily in the area of education. The government has launched many education programmes, both formal and informal. The demand for formal education arises from the 500,000 high school graduated each year. These school leavers apply to the 42 government institution of higher learning, and among them only about 18 % can actually be accepted. The rest must look for places in privite institutions, wait for next year's a entrance exam to try again, or give up their goal for a university degree. On the other hand, Indonesia's rapid economic growth and expanding need for trained manpower add increased urgency to the challenge of demographics. The existing universities and technical institutes are unable to meet the demand and fulfill the nation's needs due to a number of limitations including manpower and financing, low productivity rates, etc. Furthermore, a significant geographical obstacle to communication is imposed by the wide scattering of Indonesia's islands.

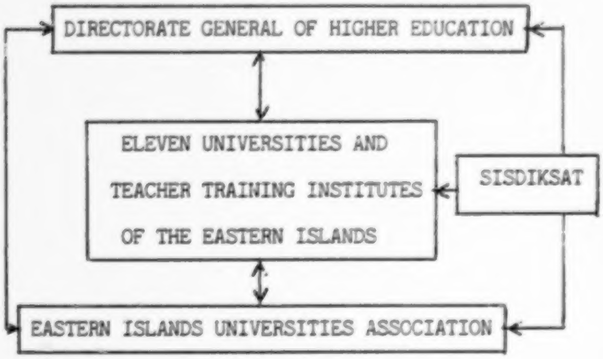
In 1981 the Directorate General of Higher Education entered into discussion with the United States Agency for International Development (USAID), represented by its Bureau of Science and Technology/Education, regarding the possibility of implementing an experiment that would explore the ways in which Indonesia's Palapa satellite system could be used for higher Education (Johari, 1985). A project agreement was signed in 1982 and actual activities were begun in 1983. The two governments decided to cooperate in the creation of a two-channel audioconferencing network that links 10 universities and the Directorate General.

The Indonesian acronym for this system is SISDIKSAT: The Indonesian Long Distance Education Satellite System.

SISDIKSAT (Shaw, 1987) utilizes two dedicated voice channels on the Palapa satellite and a four-wire ground telephone system. The technical system consists of a common audioconferencing channel with loud speakers and twelve microphones in classroom seating from 40-80 persons. The second channel can be used for a number of purposes, namely: facsimile transfer, private phone conversations, telewriting via a graphics system developed by the Open University-UK, or as a back-up channel if there are noise problems on the audio channel. Each site is also equipped with an emergency power outages. Each location is staffed with a local coordinator, local technician, and equipment operators. The overall management of the system is directed from a central office at Hasanuddin University, Ujung Pandang, South Sulawesi.

SISDIKSAT utilizes some technical innovations that are designed to reduce costs and enhance reliability. Unlike many audioconferencing system that utilize a terrestrial bridge to link multiple sites, SISDIKSAT uses the satellite itself to bridge in a "loopback" (half-duplex) design. This only allows one site to talk at a time, but it reduces the number of channels that need to be leased. One disadvantage to this low cost design is that line noise from one site can automatically be passed to all other sites. In order to prevent this from happening, SISDIKSAT has installed a gating system between the classrooms and the central telephone exchanges at each site. The gating system utilizes a signal from the classroom to close the phone circuits and allow for transmissions. It thus prevents the transmission of ambient line noise and other local disturbances to the entire network. This control of line noise is extreemely important when you are dealing with local phone lines that are very susceptible to noise. PERUMTEL, Indonesia's Telecommunications Authority, has made great efforts to provide SISDIKSAT with high quality lines.

The administrative structure of SISDIKSAT ranges over three levels: national, regional and local. It is a national project with direct input and general supervision from the Directorate General. It is a regional project in that it is based in the East (including East and South Kalimantan, Sulawesi, Maluku, and Irian Jaya) and linked to a regional association: however, its essence is the 11 local sites that make up the network. It operates between the Jakarta-based central administration and the provincial university bureaucracies. The role of the Directorate General office is to lead and coordinate, but it has no position of power or influence over any of the participants. The administrative placement can be briefly diagrammed as follows (Shaw, 1987):


DIRECTORATE GENERAL OF HIGHER EDUCATION
ELEVEN UNIVERSITIES AND
TEACHER TRAINING INSTITUTES
OF THE EASTERN ISLANDS
SISDIKSAT
EASTERN ISLANDS UNIVERSITIES ASSOCIATION

4. THE PROGRAM

SISDIKSAT connects members of the Eastern Islands University Association with the Directorate General Education and the Bogor Agricultural Institute. The primary focus of SISDIKSAT activity is on enhancing the educational and administrative goals of the Association by drawing upon the resources of all the sites. The main activities are course sharing, seminars, audioconferences, information exchange, and demonstrations that include user groups outside universities.

SISDIKSAT places its primary emphasis upon course sharing between its members. The Vice-Rectors for Academic Affairs of all institutions meet over the system to identify courses that are greatly needed and courses that they feel they are capable of delivering. SISDIKSAT staff then lead them in several meetings over a period of weeks until a decicion is reached concerning a schedule that will meet at least some of the needs of all the members. Deans and assistant deans also participate in the process as well as some other faculty members. Both the courses and the course teaching teams are identified at the same time, and the sites indicate which courses they will participate in. No site participates in all courses offered.

The Academy for Educational Development (AED) Field Manager in Ujung Pandang, describes the rationale for the project (Shaw, 1987) as follows:

1. National need for more trained manpower.
2. Great demographic pressure on the education sector.
3. Shortage of faculty and facilities.
4. Goal of doubling university enrollment by the year 2000.
5. Need to increase quantity and quality of education.
6. Need to increase the quality of access.
7. Need for institutions to share resources.

At the present time there are eleven sites participating in the satellite program. They are:

1. Cenderawasih University (UNCEN) - Manokwari (Irian Jaya)
2. Mulawarman University (UNMUL) - Samarinda (East Kalimantan)
3. Tadulako University (UNTAD) - Palu (Central Sulawesi)
4. Hasanuddin University (UNHAS) - Ujung Pandang (South Sulawesi)
5. Cenderawasih University (UNCEN) - Jayapura (Irian Jaya)
6. Sam Ratulangi University (UNSRAT)/IKIP - Manado (North Sulawesi)
7. Lambung Mangkurat University (UNLAM) - Banjarmasin (South Kalimantan)
8. Teacher Training Institute (IKIP) - Ujung Pandang (South Sulawesi)
9. Bogor Agricultural Institute (IPB) - Bogor (West Java)
10. Pattimura University (UNPATTI) - Ambon (Maluku)
11. Directorate of Higher Education (DIKTI) - Jakarta

As mentioned earlier, not all sites participate any program. One evaluation (Shaw, 1986) reports the following figures:

Attendance Per Site for Science Seminar Series

No.	Site	No. of Seminars	No. of Participants
1.	UNCEN - Manokwari	23	429
2.	UNMUL - Samarinda	18	147
3.	UNTAD - Palu	19	146
4.	UNHAS - Ujung Pandang	23	145
5.	UNCEN - Jayapura	20	118
6.	UNSRAT - IKIP Manado	18	64
7.	UNLAM - Banjarmasin	12	29
8.	IKIP - Ujung Pandang	9	23
9.	IPB - Bogor	2	6
10.	UNPATTI - Ambon	0	0
11.	DIKTI - Jakarta	0	0
	Total		1.101*

* attendance total for 23 of the 24 seminars.

Equipment available for use at each site at the present time appears in the following list.

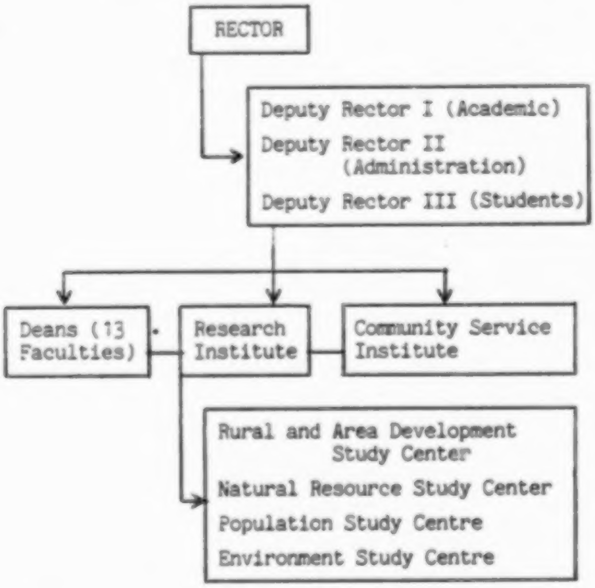
Equipment	Number	Function
Telephone Terminal	1	setting transmit and receive levels for both channels: control of dialing functions and selections of equipment on Channel B.
Audioconferencing: Channel A		
Convener	1	setting of audio receive volume: voice switching
Microphones	12	push-to-talk transmission of voice signal to all sites
Loudspeakers	2	reception of voice signal from all sites
Graphics Support: Channel B		
Conferencing Phone	1	private calls on point-to-point or multipoint basis
Facsimile	1	transfer of paper copy between sites
Telewriter	1	microprocessor, modem, light pen for transmission of handwriting or drawing
Monitors	3	19-inch monitors for telewriting directly on the screen with light pen; two 26-inch monitors for display of telewriting, video, or live television broadcasts
Signal Coupler	1	transfer of graphics signal from microprocessor to the 26-inch video display monitors
TV Tuner	1	reception of off-air broadcasts
Tape Recorder	1	taping audio or graphics signals and replaying pre-recorded graphics tapes
Emergency Power Supply		backup power system consist of rechargeable batteries, charger, voltage stabilizer, and inverter to supply electricity for the audioconferencing system for up to 12 hours without recharging

5. THE ROLE OF THE RURAL AND AREA DEVELOPMENT STUDY CENTER

This study center is one of the four centers within the Research Institute of Hasanuddin University. The other three are the Population Study Center, the Environment Study Center, and the Natural Resource Study Center. The centers are autonomously active in launching their programmes, under the coordination of the Research Institute.

The main concern of the Rural and Area Development Study Center is to enhance the quality of life of rural communities, primarily those in the eastern islands. Its programmes consist of research and development programmes. There have been many issues covered in research work such as traditions, traditional farming, traditional fisheries, social and political systems within the rural community, and history. In the field of development, the center, in cooperation with the university's community development bodies, is launcing programmes of enhancing rural technology. The programmes are based on the outcomes of research done by the Center.

The position of the Center within the hierarchical structure of Hasanuddin University is shown in the diagram:


RECTOR
Deputy Rector I (Academic)
Deputy Rector II (Administration)
Deputy Rector III (Students)
Deans (13 Faculties)
Research Institute
Community Service Institute
Rural and Area Development Study Center
Natural Resource Study Center
Population Study Centre
Environment Study Centre

The report of the most recent SISDIKSAT evaluation conducted at the last Eastern Islands University Association annual meeting (Meeting's Report, 1988) in Samarinda (East Kalimantan) shows that the program has satisfied all the participating universities. Both technical aspects (equipment maintenance) and the teaching program were considered to be successful so far. The challenge now centers on the question of how to maximise the output of the program, so that the real goal of enhancing the quality of life of the whole population can be reached soon.

Theoretically, the program launched by SISDIKSAT is well structured. The teaching goal is relatively fixed. The students are from the participating universities. The subjects taught are in disciplines within the universitie's field of expertise, and the lecturers are recruited from the participating universities themselves. Therefore, the main matters requiring attention are certain technical problems and the organization of the staff members to meet program needs.

The idea of including a program consisting of instruction regarding appropriate technology designed for a broader audience is indeed an idea which requires further study. Preliminary study carried out by the Rural and Area Development Study Center has led to the following suggestions:

1. The program should make use of the existing organization of the SISDIKSAT which has proven a success so far.
2. A further study should be made regarding:
    a. Location for extention services.
    b. Technical and economic feasibility with the principle of making use of locally available materials which are domestically produced.
    c. Availability of artists for preparing teaching modules.

6. CONCLUSION

Hasanuddin University, the coordinating university in the SISDIKSAT program, is taking a leading role in developing new ideas to help the rural communities free themselves from poverty inprisoment. Its resources which include a teaching staff of 1420, a student body of 20,000, and a modern campus must be utilized as the academic community responds to the strong moral incentive to contribute to the welfare of the rural population, in the eastern islands.

This PTC conference, to my understanding, provides a golden opportunity for this non-metropolitan university to share its thoughts and ideas. I believe that the end goal of all our current efforts is the enhancement of the quality of life for the entire human race, including those members who live in the eastern islands of Indonesia. Therefore, at this time I would like to ask that you give thought to the plans I have outlined briefly, and provide me with your thoughts and assessments from technical and economical point of view.

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Session 6.2

Rural and Remote

NOTES

DELIVERING HUMAN SERVICES IN REMOTE LOCATIONS:
Designing Wide Area Networks

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ABSTRACT:

The human services are one of the primary beneficiaries of telecommunications networks in remote areas. Distance learning, shared databases, and high-bandwidth communications are examples of services that can be utilized by schools, hospitals, and other social agencies. In fact, the explosive growth of communications technology has created a menu of capabilities which the human services are frequently unable to use creatively and efficiently. This is due, in large part, to the lack of a comprehensive perspective on the human services from which telecommunications system designs might be developed.

This paper presents a view of the human services which centers on their information base and the communications links needed to deliver programs to clients. The perspective outlined in this paper is "client-centered" so that it draws its summary of communications needs from the requirements of services and clients rather than from the menu of available technology.

REMOTE AREA NETWORK DESIGN:

Much of existing telecommunications network design for remote areas has been based on a "highway department" approach. To quote from a recent network design paper. "In a conceptual way, STARS is like an interstate freeway for communications travel...Freeways fit in with other state and local roads to form a large transportation system. That is similar to what STARS will do. (1)

In the above quotation, STARS is an acronym for Statewide Telecommunications Access and Routing System; a system that is to link a wide range of government and human services for rural Minnesota. By applying the highway metaphor, STARS designers are taking the position that users will be able to define how the proposed utility will support their activities. However, the designers fail to recall that freeways were called into being by existing needs for travel; they were networks which grew out of the communications needs of individuals, towns, and cities. They are based on the design principle that highways facilitate travel between population centers.

The analogy in the human services is to base network design on a set of principles which insure communications among service providers for the benefit of the client. In order to arrive at a set of workable principles, it is necessary to:

a) identify existing communications patterns.

b) determine how improved flows of information enhance the cost-effectiveness of service delivery.

c) project the evolution of service delivery to provide for future communications needs.

HUMAN SERVICES IN THE 1990's:

In most developed nations, there is an emerging consensus on the nature of the human services. This point of view can be characterized as "client-centered" in that programs and services are designed to meet the unique needs of the individual client. Service providers implement this perspective by classifying clients into groups or categories which have common service needs. Thus, we find Diagnosis Related Groups (DRGS) in acute care, Resource Utilization Groups (RUGS) in long term care, Levels of Service for school-age children, and Disability Groups (DGS) for the mentally retarded. Membership in a particular group qualifies the client for specific services and provides for the resources needed to insure quality care or treatment.

The client-centered approach to the human services is necessarily information intensive. Diagnostic decisions used for determining client need and placement are based on comprehensive assessments of individual condition. Program planning and service delivery are driven by information concerning the efficacy of various treatments and interventions. Management policy and operational plans are based on historical records of service costs and benefits. In each instance, decisions are data-based both within and across organizations.(2) It follows that any effective telecommunications system must facilitate the collection, storage, transmission, and retrieval of client data. Further, that system must guarantee that information can follow the client in his/her interactions with a variety of human service providers.

The design problem is complicated by the fact that client information is used in at least three ways in the human services. First, it is applied at the point of care to tailor services to the needs of the individual. In the emerging model of service delivery client care is based on an assessment of condition. The service provider then selects an appropriate treatment or intervention according to the diagnostic rules of the caring profession.(3)

Secondly, information is aggregated within provider organizations to assist managers in making efficient use of resources. This application constitutes a base for case-mix management within the organization whereby resources are apportioned to organizational units according to the types of client needs faced by each unit.(4)

Finally, these data are aggregated at higher levels of government to permit policy analysis and development. At this level, aggregated data are used to identify groups of clients with similar service needs. When combined with service cost information, client groupings facilitate case-mix funding of a variety of programs and services. This is increasingly the case for human services funded by state and federal governments in the United States.(5)

These general requirements for information collection and use are lodged in a system of service delivery which is rapidly changing. The traditional human services were institutional in that clients came to organizations to receive services. In recent years, there has been a significant shift away from the institutional model toward a new set of links between client and service provider. In many cases, these models serve the client in his/her own home in order to take advantage of support systems already in place.(6)

In remote areas, the press for a non-institutional model of service delivery is intensified by low population density. In fact, most remote area clients can only be served through the use of these emerging models of service delivery. This creates an environment where telecommunications technology can play a significant role - but only to the extent that there is a functional 'match' between the information needs of the human services and the features of the telecommunications network.

Up to this point, the services we have described are those where the client must interact in some way with a professional service provider. These services use information to shape the professional-client interaction. Information is, in these cases, supportive of service delivery.

There is a second type of human service where information itself is the "service" offered to the client. Education, public records, governmental information, and similar services are included in this category where information is passed to and received from the client.

Remote area education is an example of the use of information intensive services. A recent set of reports summarizes such applications as: a) the use of interactive video to train agricultural workers in remote areas b) the use of satellite transmission to diffuse health care information, and c) the use of interactive radio for rural development assistance. (7)

In addition to education and development, there is a growing awareness among government officials that many interactions between citizens and government agencies can take place using communications technology. In a recent report, the United States Office of Management and Budget predicted that nearly 75 percent of these types of transactions will be carried by electronic media by the year 2000.(8) This means that telecommunications network design must incorporate those information flows which link individuals to a wide range of government agencies.

PRINCIPLES OF NETWORK DESIGN:

The service systems described in the above paragraphs point to several guidelines or principles which can help to shape telecommunications network designs in remote areas. They are discussed below along with examples of designs which embody the features they suggest.

1) INFORMATION COLLECTED AT THE POINT OF SERVICE DELIVERY IS THE BASIS FOR ALL COMMUNICATIONS IN THE NETWORK.

This principle gives first place to the interaction between client and service provider. It grows out of the fact that service providers describe clients using measures and assessments which are readily interpretable by the professionals in the system. These data are packaged in a profile of the client which indicates service needs and points to appropriate care and/or intervention.

An example of comprehensive client information is found in the so-called "minimum data set" mandated by the United States government for long term care clients. (9) This data set contains measures taken on the elderly person by all providers in the United States. It gives form to the client's service experience in that all federal funds for long term care are linked to some aspect of client condition as indicated by the elements in the data set.

The same can be said of client information in the other human services. Medical records are fairly uniform across hospitals and clinics. Information required by welfare and social service programs is generally defined in the administrative rules which govern their operation. And, state education systems are increasingly demanding a standard data set for school children.

These data sets have important implications for telecommunications system design. Their size and the volatility of the information they contain requires that they be compute-stored and available for updating in an interactive mode. Service providers must be able to recall these data sets on demand and must be able to edit them to indicate important changes in client condition and/or need.

Example (1): Student Data Base:

The State of New York has prepared a client database design for students with disabilities. (10) This design assigns the responsibility for data collection to local school districts according to data definitions established by the State. The system is networked through Regional Computer Centers. This makes it possible for the Department of Education to monitor data definition and to update software as needed.

Central software control in the Part 200 Management System (as it is called) also insures that schools comply with State guidelines for program scope. By defining the data elements associated with student programming, the State can put new initiatives into action in a relatively short period of time. There is, at this point, no upward flow of data in the system. Local school districts can make upload decisions as they wish. The only mandated data movement is that information must follow the student from school to school. Thus, the Part 200 System does not provide for the level of data use found in the following Design Principle.

2) CLIENT DATA MUST BE INTEGRATED WITH PROGRAM AND RESOURCE USE INFORMATION TO PROVIDE A COMPLETE RECORD OF EACH SERVICE EPISODE.

In this Principle, a service episode refers to the interaction between a client and a provider. The episode record includes the minimum client data set, diagnostic decisions about client need, services provided, and records of resources used. It represents a comprehensive management overview of the service delivery operation as applied to the client.

This presents two kinds of issues for the network designer. First, he/she must insure that data collection, storage and retrieval software is consistent across all users in the network. A "software discipline" must be designed into the network to control software implementation and to provide for updating. This should be done interactively so that all users receive changes at the same time.

The second issue is that each user organization requires some form of internal network to facilitate its use of client and program data. These needs, must be met by the designer so that existing local networks can be merged into the wide area network. Since many of these networks are already in place, the designer cannot completely control local network standards. Instead, he/she must have a "game plan" for incorporating a wide range of voice and data networks into the proposed wide area network. (11)

Local area network management is also an important issue in the over-all design task. As these local networks become large and complex, they require local management to insure high levels of functionality. Since the personnel needed for local network management is not now available in most remote areas, there must be a significant training component in the wide area design. This is especially true for those local networks which rely on mixed media and long-distance transmission where network failures may be relatively frequent.

With the local network aspect of the design in place, the designer needs to consider how data can be accessed by organizations and agencies throughout the network. This is especially important for human service policy administration and analysis. Service episode data are combined with client descriptions in the minimum data set to enable the analyst to identify emerging policy needs and to evaluate the efficacy of current programs.

Example (2) Integrated Data Base:

The State of Minnesota has developed an integrated data base for its public elementary and secondary schools. This data base is fully defined by a Data Dictionary which specifies the content and format of student and school records. (12) The data base links information on all aspects of school operations including; staff characteristics, staff assignments, staff training, school descriptors, finance activities, student descriptors, student schedules and enrollment.

The structure of the database is such that all common management questions can be addressed by appropriate queries. Schools can also define reports needed for local managers and can make comparisons between their organizations and others on a variety of indicators. The aggregation capability of the systm allows policy analysts the access to data needed for policy studies.

The database design does not, however, provide for central control of the local network. Instead, it relies on local autonomy and discretion of use with centralized reporting. Despite the high level of local control, the system has the capacity to shape school programs through data definition and comparison reporting.

It could be said that this application generates a need - one which is spoken to by our third Design Principle.

3) NETWORK DESIGNS MUST BE SUFFICIENTLY FLEXIBLE TO PROVIDE FOR EVOLVING SERVICE DELIVERY MODELS AND FOR NEW SERVICES WHICH MAY COME INTO BEING.

This is not a particularly new idea. Network designers have always attempted to make their systems flexible and open to new applications. However, this Principle sets a somewhat greater challenge for those working with the human services. This is due to the earlier-mentioned fact that the service models used by providers are changing. Standard, time-proven designs may not match the configuration of the human services in the future.

While current networks must support the institutional framework of the human services as they exist at present, they must also be open to "client-centered" models of service delivery. In these models, the client is the initiator of communication and his/her needs dictate the flow of information to and from service providers and governmental agencies.

The central role of the client in future service delivery models suggests that he/she be given access to high-bandwidth communications which can be switched to any point in the network. In other words, design biases toward high network capacity are more likely to position the network for future demand than are lower capacity strategies.

Future communications requirements are also partly determined by changes in the economic and social conditions in remote areas. The following example shows how new service needs can be made to interface with existing communications networks.

Example (3) Agricultural Injury:

Public health officials in many rural areas have noted a persistent pattern of agricultural injury. The prevalence of these problems has been traced to a combination of agricultural production technology and the socio-economic environment of rural communities. (13) In order to reduce injury under these conditions, farm families need training in injury prevention as well as technical support to modify production practices.

Studies of injury have also shown that the traditional systems of agricultural extension and education do not reach the population at risk. This has resulted in a service design which relies on two-way interactive video networks already in place in rural Minnesota. The excess capacity designed into these networks proves to be more than adequate to carry the instructional component of injury prevention. The network can also accommodate farmer-initiated communications directed at injury management experts.

Integration of injury management into the existing video network facilitates policy studies in accord with our Second Principle. As farmer questions and problems are aggregated, it is possible to identify emerging problems and injury patterns so that preventive education and production controls can be initiated.

In this example, client need is the occasion for a new network application and a new set of communication flows has been added to the existing exchanges on the network. This is an instance of the evolutionary nature of the network as stated in our Fourth Principle.

4) THE ACTUAL CONFIGURATION OF NETWORK COMPONENTS IS BASED ON EXISTING DATA AND VOICE TRAFFIC.

All networks must be built on existing communications facilities. Even remote areas are not exempt from this basic premise. Voice and data traffic patterns must be accommodated by new network designs. In effect, all existing networks and communications links must be "folded into" the new design.

This Principle is not intended to limit designs to existing architectures, nor does it suggest that current traffic is the ultimate design target. Instead, it argues that communications systems now in place must have a planned phase-in to the new network. Consequently, designers must have a clear picture of the communications traffic generated by the human services as well as a complete inventory of the equipment and networks in operation. By dividing current traffic ty type of human service, projections can be made of expected changes in communications flows. These baseline projection can be augmented by analyzing new services and demand according to the first three Design Principles.

As the designer builds upon current telecommunications systems, he/she must be aware of the shift from voice to data communications in the human services. As our First Principle points out, services are increasingly data based. These data will place large demands on any new network design as they take first place in policy implementation.

Example (4) Voice/Data Network:

The State of Georgia has recently designed a statewide voice-data network. This is a wholly digital system with switching nodes in each of the state's five local access and transport areas (LATAs).(14) These nodes are located in Souther Bell central offices and are managed by telephone company personnel with traffic data flowing to the state Network Management Center.

Links to local users are provided through a set of seventy PBXs located in regional centers. These are strategically placed to concentrate traffic so that dedicated T1 services can be utilized. These links provide high-capacity data pathways to state computing facilities; making it possible for the data-intensive human services to function across the state.

SUMMARY:

The key point of the above discussion is that designers cannot separate communications flows from the underlying models of human service delivery. As these models change to become more data-intensive and less institutional in nature, their communications needs will undergo revolutionary developments. By anticipating these changes, designers can configure networks which have a high probability of meeting future communications needs.

It is important to note that our Design Principles are only a first approximation. They will clearly need to be refined as new human service models become widely adopted in remote areas. At the same time, there is an underlying set of social and economic conditions which drive the human services. These are forces which we have not addressed in our Principles; they may be a significant limitation on the value of the Principles in any given problem.

Research currently underway in Minnesota is directed at refining human service delivery models. As the results of this work becomes available, these Design Principles can be modified to better define the communications needs of clients and service providers.

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RURAL TELECOMMUNICATION NETWORK ADOPTING SMALL CAPACITY MICROWAVE RADIO SYSTEM

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Circumstances of telecommunications in rural areas are much behind compared with those of urban areas. It is important that rural areas are to be developed keeping balance with urban areas using appropriate telecommunications. The system aims at easy and economical spreading of telecommunication service to the people, in less populated areas where there are no telephone facilities available, by extending subscriber lines with radio circuits from the existing local exchange. This can be attained in two ways. One is Demand Assignment Time Division Multiple Access system studied by CCITT using digital technology. The other is to introduce digital microwave system with a small capacity for subscriber line extension featuring service as trunk lines for such areas in the future. The latter system has recently been constructed by Japanese consortium in the Kingdom of Nepal which will a good example for introducing in PTC's 12th Annual Conference.

1. Necessity of Rural Telecommunication System

Telecommunication networks are indespensable for administration, public piece and medical services as well as activities in rural area. It goes without saying that circumstances of telecommunications in rural areas are much remained behind compared with those of urban areas.Therefore, it is important that the rural areas are to be developed keeping the balance with the urban areas using appropriate telecommunications. The rural telecommunication system has been studied by CCITT.
The development has been promoted in many countries in the world especially as the measure for satisfying communication requirements in rural areas in developing countries. It has now entered the practical operation.

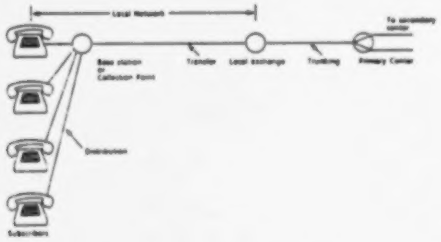

Fig. 1 RURAL TELECOMM. SYSTEM (CCITT)

As shown in the above figure,the system aims at easy and ecomomical spreading of telecomm. service to the people in depopulated areas where are no telephone facilities available by extending subscriber lines from the existing local exchange. With advanced digital technologies,digitized trunk lines using microwave or fiber optics systems are rapidly increased. It is desirable, therefore, to employ a digital system for rural telecommunications in terms of network matching. Digital microwave, fiber optics, fixed satellite, movile and DRCS (Digital Radio Concentrator System) or DATDMA (Demand Assignment Time Division Multiple Access) Radio System are considered for rural telecommunication systems. Each having specific features, topographies, number of subscribers required,distances from subscribers and effective frequency utilization should be considered. The system design should be carried out combining various systems in order to meet actual network requirements. For example, it can be recommended in view of effective frequency utilization and future network expansion that,

1) small capacity microwave systems can be aggresively employed because of its sharp antenna beams and high interfence resistance

and also,

2) DRCS (Digital Radio Concentrator System) is suitable for accomodating scattered subscribers.

As described above, two main current systems are recommended for rural telecommunication networks. One is an ordinary small capacity digital microwavesystem and the other is a recently developed DATDMA Radio System. The former is defined as one of the system in CCIR recommendations for composing rural telecomm. network. This system serves connections between rural areas or between rural and urban area and designed to meet severe enviromental conditions as well as other diverse requirements. On the other hand, along with nation's guidelines, the digital rural network concept is rather commonly known to introduce because the network can be easily expanded in future and also has various advantages. With this background, it will be a main stream to support the rural telecomm. networks. The latter, DATDMA Radio System is also defined as one of the system in CCIR recommendations for rural telecommunication networks. This system serves connections between urban and rural area especially for scattered subscribers and is designed to meet severe environmental conditions in rural area.

2. TYPICAL TRANSMISSION SYSTEM

Small capacity microwave system is at most 8 or

34 Mb/s and mainly used for local towns or villages having less traffic. Figure 2 shows typical transmission system application in route construction.

UHF band is very popular for small capacity radio system but interference problems are raised in most cases. Especially in the band of 400MHz, sufficient care shall be taken against the city noise at the planning.

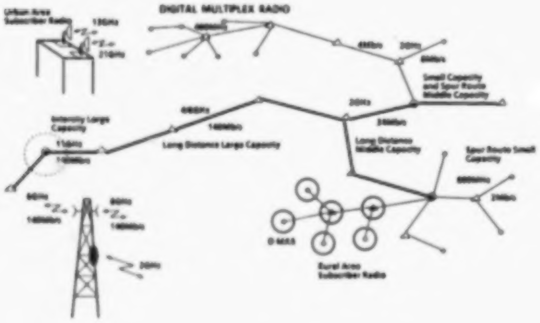
DIGITAL MULTIPLEX RADIO
Urban Area Subscriber Radio
Small Capacity and Spur Route Middle Capacity
2GHz
Intercity Large Capacity
Long Distance Large Capacity
Long Distance Middle Capacity
Spur Route Small Capacity
Rural Area Subscriber Radio

Fig. 2 TYPICAL SYSTEM CONSTRUCTION

3. APPLICATION OF SMALL CAPACITY DIGITAL RADIO SYSTEM FOR RURAL TELECOMMUNICATION NETWORKS

In UHF bands, 400, 800 MHz, 1.5 and 2 GHz are generally used for 2,4,8 Mb/s and sometimes for 34 Mb/s. Figure 3 shows a image of UHF band small capacity digital radio equipment.

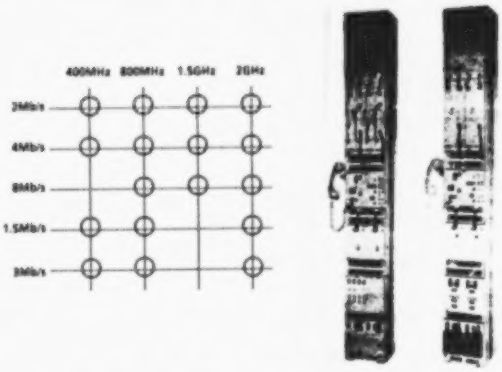
400MHz
800MHz
1.5GHz
2GHz
2Mb/s
4Mb/s
8Mb/s
1.5Mb/s
3Mb/s

Fig. 3 IMAGE OF SMALL CAPACITY DIGITAL RADIO EQUIPMENT(UHF BAND)

SHF and EHF bands are also used for small capacity radio network having the capacities from 1.5 to 6 or from 2 to 8 Mb/s but mainly used for short haul circuits due to the rain fall attenuation because of their higher frequencies. In addition to the above, these bands are also used for a large capacity radio link to transmit vast information between the city buildings with short distance.

Figure 4 shows a image of SHF/EHF bands small capacity digital radio equipment.

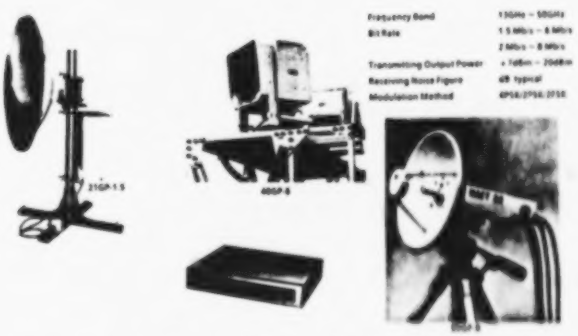
Frequency Band
Bit Rate
1.5 Mb/s ~ 6 Mb/s
2 Mb/s ~ 8 Mb/s
Transmitting Output Power
Receiving Noise Figure
Modulation Method

Fig. 4 IMAGE OF SMALL CAPACITY DIGITAL RADIO EQUIPMENT(SHF/EHF BANDS)

In the UHF applications, Digital Mini Radio System has come into the Market as a hot menu. The equipment has the capacity of 6 telephone channels and is accomodated in a compact cabinet. Applicable radio frequency bands are 400, 800MHz and 1.5GHz with different models. These are all designed to be applicable to the local grade circuit of CCIR Rep.No.1053. Besides 6 telephone channels,an order wire is equipped as a standard and an user's data channel is available for data communication such as Fax.as an option. Figure 5 is an image of Digital Mini Radio Equipment.

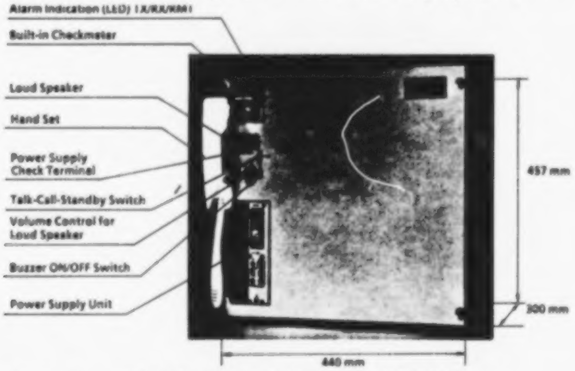
Alarm Indication (LED) TX/RX/RMI
Built-in Checkmeter
Loud Speaker
Hand Set
Power Supply Check Terminal
Talk-Call-Standby Switch
Volume Control for Loud Speaker
Buzzer ON/OFF Switch
Power Supply Unit
457 mm
300 mm
440 mm

Fig. 5 IMAGE OF UHF DIGITAL MINI RADIO EQUIPMENT

4. INTRODUCTION OF THE RURAL TELECOMMUNICATION NETWORK IMPROVEMENT PROJECT IN THE KINGDOM OF NEPAL

The Rural Telecomminication Network Improvement Project of Nepal was completed the year before last by NTC (Nepal Telecommunication Corporation) with the aid of Japanese government. The aim of this project was to shorten access time that had been taken one week to reach telephone facilities to six hours. For this purpose, the territory was divided into 9 areas by planning and the construction phases were provided from first to fourth. This time, the first and the second phase have been completed for 7 areas. That means 46 stations have been constructed. The project has been constructed by Japanese consocium which was undertaken by Mitsubishi Corporation as the contractor, and jointly executed by Kanematsu-Gosho Ltd., Oki Electric Ind. Co.Ltd, and Japan Radio Co.Ltd. as suppliers and installers of equipments with the technical assistance of The Nippon Telecommunication Consulting Co.Ltd. as the project consultant and under the engineering supervision of Nepal Telecommunication Corporation.

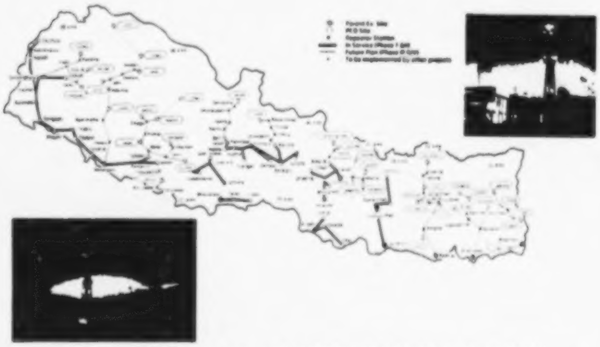

Fig. 6 EXPANSION OF TELECOMMUNICATION NETWORK IN THE RURAL AREAS

On the construction, Oki Electric took Charge of 3 areas where are in the mountaineous and cliffy. Figure 6 shows the expansion network map of Nepal.

Area	01	04	05	06	07	08	09	Total
No. of P.C.O	2	3	4	8	4	4	8	33
Repeater Station	4	2	3	6	4	2	4	25
2GHz Band Digital Radio Equipment								
2Mb/s	6	2	4	4	6		4	26
4Mb/s (2Mb/s x 2)		4	2	10	4	3	7	30
8Mb/s	2			6		2	4	14
17Mb/s (8Mb/s x 2)	2		4	4		4	4	18
34Mb/s		2				2	2	6

Table 1 SYSTEM OUTLINE

The project has been aimed to install PCO in no telephone area to support their social and economic activities and also to improve the government activities. At present, based on the small capacity wide band microwave network the system is connected between central exchange and PCO or ordinary subscribers. TABLE 1 shows the system outline in which includes the number of PCO installed in each area. As a radio system, 2GHz band is used with the capacity of 2 to 34Mb/s but not fully equipped. This is for the consideration to be diverted the system to future's main route in each local area.

New equipment shelter is provided at the site where existing accomodation is not available. Such station having no access road in many case, all materials such as equipments and shelters had to be transported by local people's power and their corporations.

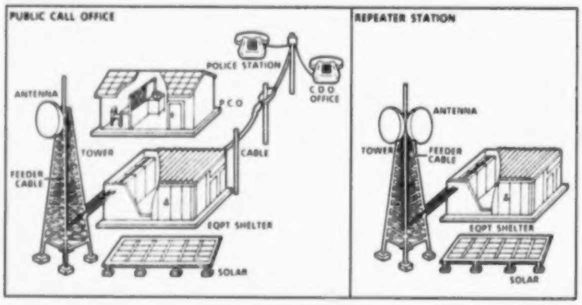

Fig. 7 SITE CONFIGURATION

The shelter is a pre-fabrication type which was carried on local people's shoulder.As illustrated in Figure 7, charging is done by operator in PCO. All repeater stations are operated unattendant. Access roads were almost animal paths and not being commercial power supply available, solar power has been proved powerful.

Regarding to the PERFORMANCE OBJECTIVE, the bit error ratio should not exceed the following values :

1×10^{-6} during more than 0.4 % of any month; integration time one minute,

1×10^{-3} during more than 0.0061% of any month; integration time one second

and for real digital radio-relay links:

Pi = (Between PEO and PCO) X 0.0015 %

The above standard is the NTC requirement.

While, FADING OCCURRENCE PROBABILITY (F.O.P.) is described in CCIR Report No.338-5 and the empirical value of paremeter requested by customer was N.W.Europe from the Report.

$$F.O.P. = K Q \times f^{B} \times d^{C}$$

where, d : path length (km)
f : frequency (GHz)
K Q : factor for climate conditions and terrain conditions (1.4×10^{-8})
B : constant factor (1.0)
C : constant factor (3.5)

The numbers parenthesized are the data from N.W.Europe in the Report.

Figure 8 shows an example of system block diagram in 08 area between Rajhakot and Nepalgunji having the capacity of 34 Mb/s with route stand-by system.
As the basic policy of designning,

1) route stand-by system is adopted for 34 Mb/s
2) set stand-by system is adopted for 2 to 17 Mb/s.

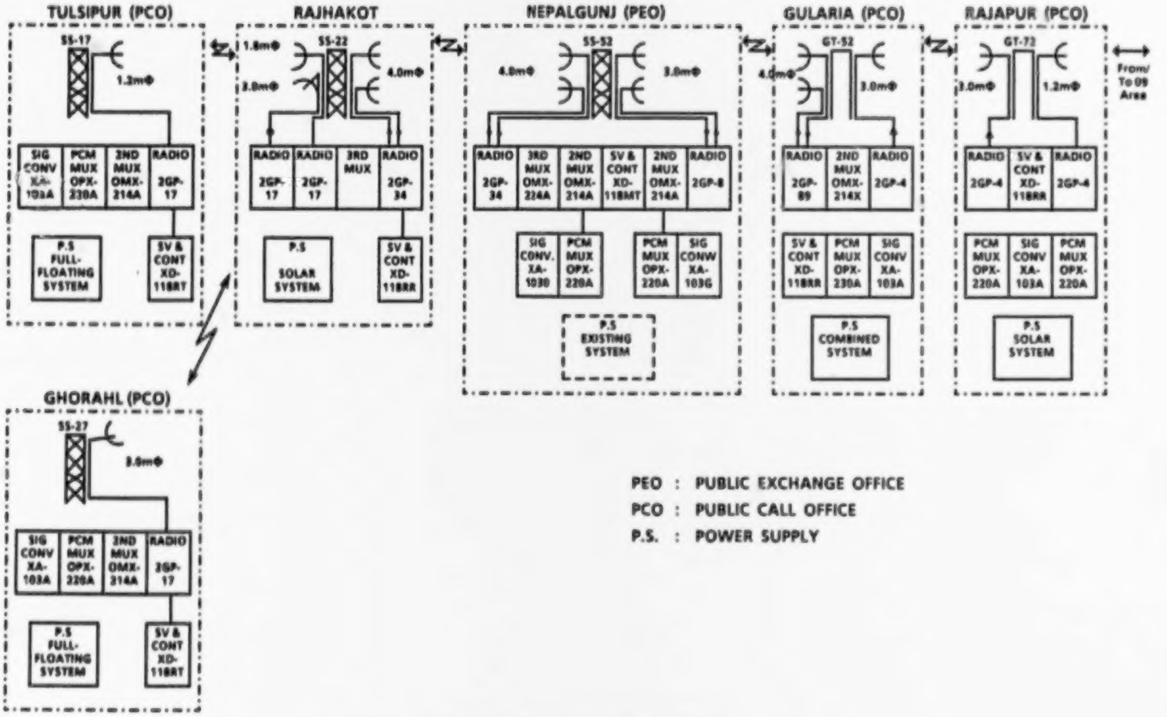
TULSIPUR (PCO)
SS-17
1.2mΦ
SIG CONV XA-103A
PCM MUX OPX-220A
2ND MUX OMX-214A
RADIO 2GP-17
P.S FULL-FLOATING SYSTEM
SV & CONT XD-118RT
RAJHAKOT
SS-22
1.8mΦ
3.0mΦ
4.0mΦ
RADIO 2GP-17
RADIO 2GP-17
3RD MUX
RADIO 2GP-34
P.S SOLAR SYSTEM
SV & CONT XD-118RR
NEPALGUNJ (PEO)
SS-52
4.0mΦ
3.0mΦ
RADIO 2GP-34
3RD MUX OMX-224A
2ND MUX OMX-214A
SV & CONT XD-118MT
2ND MUX OMX-214A
RADIO 2GP-8
SIG CONV. XA-1030
PCM MUX OPX-220A
PCM MUX OPX-220A
SIG CONW XA-103G
P.S EXISTING SYSTEM
GULARIA (PCO)
GT-52
4.0mΦ
3.0mΦ
RADIO 2GP-89
2ND MUX OMX-214X
RADIO 2GP-4
SV & CONT XD-118RR
PCM MUX OPX-230A
SIG CONV XA-103A
P.S COMBINED SYSTEM
RAJAPUR (PCO)
GT-72
3.0mΦ
1.2mΦ
RADIO 2GP-4
SV & CONT XD-118RR
RADIO 2GP-4
PCM MUX OPX-220A
SIG CONV XA-103A
PCM MUX OPX-220A
P.S SOLAR SYSTEM
From/ To 09 Area
GHORAHI (PCO)
SS-27
3.0mΦ
SIG CONV XA-103A
PCM MUX OPX-220A
2ND MUX OMX-214A
RADIO 2GP-17
P.S FULL-FLOATING SYSTEM
SV & CONT XD-118RT
PEO : PUBLIC EXCHANGE OFFICE
PCO : PUBLIC CALL OFFICE
P.S. : POWER SUPPLY

Fig. 8 08 AREA SYSTEM BLOCK DIAGRAM

PCO telephones are usualy handled and charged by means of operator. They have no dial facilities. Figure 9 shows a typical terminal configuration.

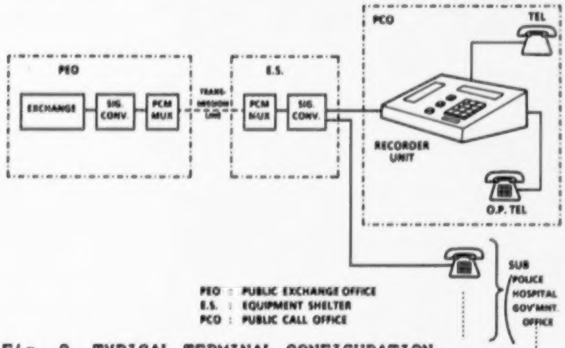
PEO
EXCHANGE
SIG. CONV.
PCM MUX
TRANSMISSION LINE
E.S.
PCM MUX
SIG. CONV.
PCO
TEL
RECORDER UNIT
O.P. TEL
SUB
POLICE
HOSPITAL
GOV'MNT. OFFICE
PEO : PUBLIC EXCHANGE OFFICE
E.S. : EQUIPMENT SHELTER
PCO : PUBLIC CALL OFFICE

Fig. 9 TYPICAL TERMINAL CONFIGURATION

The charging is carried out by operator with the key operation of recorder unit and the time count is started as soon as it is switched over to the subscriber telephone. When the communication is over and hooked off the hand-set, the time counting is automatically stopped and the printer in the recorder unit prints out the commenced and terminated time as well as the duration of time. For signalling interface, 4W/E&M signal coming from PCM Mux. is converted in to 2W/Loop at signal converter and vice vasa.The signal converter has also a repeating facility of charging pulse for future's coin telephone. Applied dial signal which depends upon the exchange is MFC in case of Nepal. Figure 10 shows actual PCOs installed at their local sites.

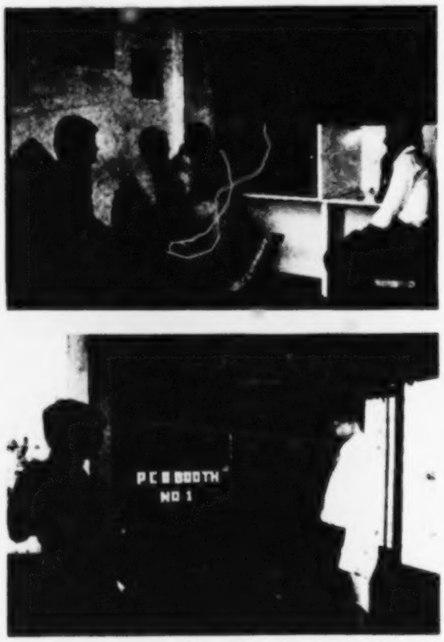
PCO BOOTH
NO 1

Fig. 10 PCO WITH THE PEOPLE WAITING FOR PHONE-CALL ON THE LINE AND TELEPHONE BOOTH

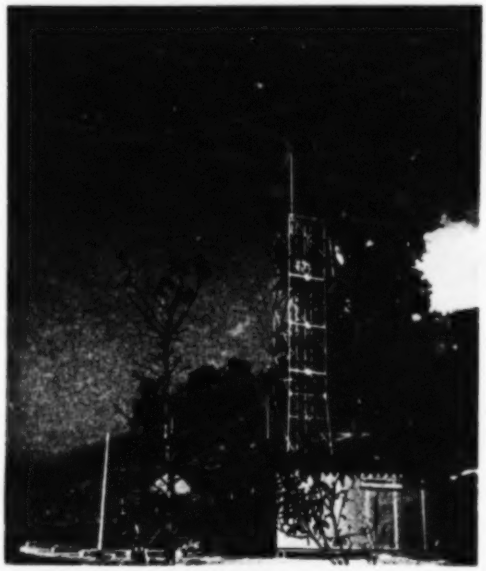

Fig. 11 A SITE WITH SELF SUPPORTING TOWER

Towers are included self supporting, guyed wire and panzer past types which withstand 160 km/h of wind velocity. The concrete tower foundations are also included for the project. Antennas are grid type of 2GHz band and feeders are coaxial type. Figure 11 shows a site with self supporting tower.

Three types of power supply systems were supplied and those are,
  1) float-charging rectifier system,
  2) solar power system and
  3) combined system

Float-charging rectifier system was adopted to the station where commercial power supply is available. The system is an orthodox type composed of two diesel engine generators for back-up of commercial power supply and applied to the terminal station to where is easily accessible with existing road.

Solar power supply system was adopted to the station where commercial power supply was not available and had difficulty in obtaining any access road.

Combined power supply system was effective for the station where was a commercial power supply available but had difficulty in obtaining access road. This system is, what is called, a hybrid system using the solar power instead of diesel engine generator. Figure 12 shows the circuit block diagram of combined power supply system.

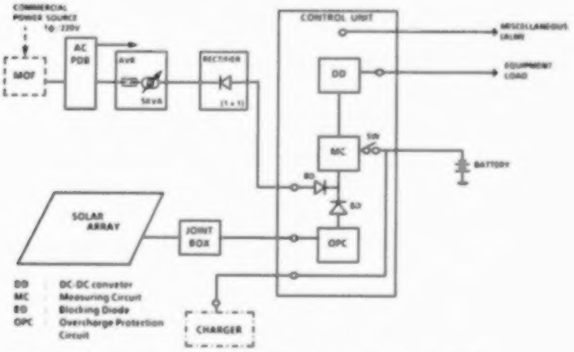
COMMERCIAL POWER SOURCE
1φ 220V
MDF
AC PDB
AVR
5kVA
RECTIFIER
(1+1)
CONTROL UNIT
MISCELLANEOUS (ALM)
DD
EQUIPMENT LOAD
MC
SW
BATTERY
BD
BD
SOLAR ARRAY
JOINT BOX
OPC
CHARGER
DD : DC-DC convetor
MC : Measuring Circuit
BD : Blocking Diode
OPC : Overcharge Protection Circuit

Fig. 12 CIRCUIT BLOCK DIAGRAM OF COMBINED POWER SUPPLY SYSTEM

In this connection, it might be added that at the station where is no commercial supply available a hybrid system with windmill generator and solar systems combined are sometimes useful. But, it should be determined if adopted or not by careful examination of the environmental and economical conditions where to be installed.

Many shelters were installed as radio stations in mountain sites. Three types of shelters were supplied which were called equipment shelters, rectifier/battery shelters and engine/generator shelters. All shelters were pre-fablication types and transported by man-powers and domestic animals piece by piece in case of no access road available. Moreover, many equipments and materials, not only shelters but also, heavy weighted materials such as tower angles, cable drums etc. were transported by the same way with coming up to 500 porters and several hundreds of donkeys. Figure 13 shows shelters installed at a site

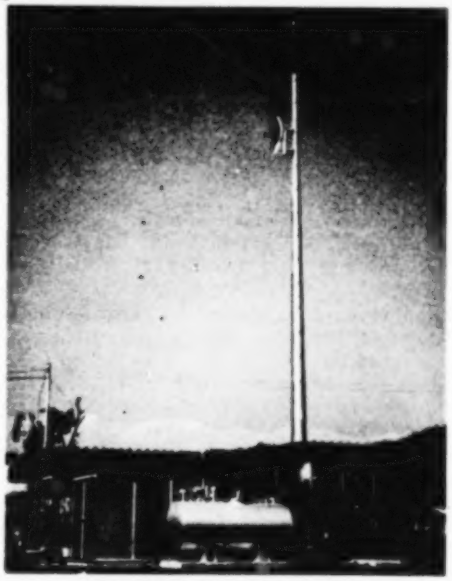

Fig. 13 SHELTERS AT SITE

Training in Japan had been carried out before commencement of the installation. Seven staff engineers were received for three months and trained from the theory to maintenance technique. Training in Kathmandu was also carried out for 20 responsible technicians from each area including On the Job Training.
Figure 14 shows the photos taken at the closing ceremony in Tokyo(top) and in Kathmandu(bottom).

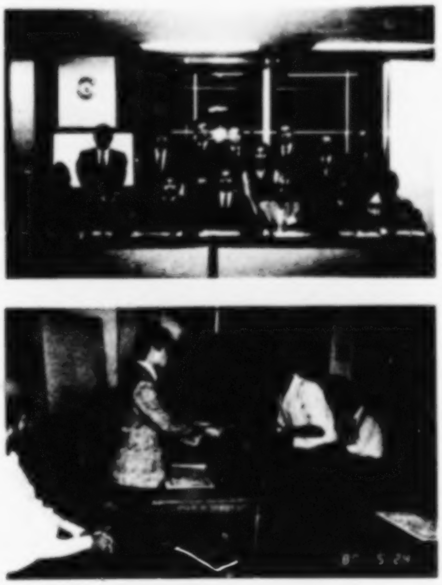

Fig. 14 TRAINING

5. CONCLUSION

It has been passed more than one year since the project was seviced in.
In order to establish technology transfer as soon as possible, engineers are dispatched from Japan to Nepal for one month in three months interval. Having been obtaining good results from this practice, the maintenance organization is arranged smoothly and the network is operated with much satisfaction.

In conclusion, the telephone traffic data shall be introduced for a reference. The data were obtained from several Public Call Offices in 06 area. The graph in Figure 15 shows the summerized phone-call number plotted monthly in each PCO. The telephone traffics are steadily inceasing every month.

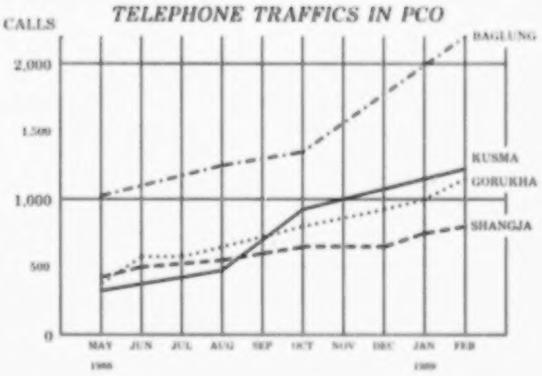

Fig. 15 TELEPHONE TRAFFICS IN PCO

It is the fact that the completion of this project gave Nepalese peoples living in local areas a great impact on their livings. NTC is now working hard on planning for allover the country to shorten access time to reach telephone facilities from one week to six hours as previously described.
It will be no exaggeration to say that this project is one of the most successful examples in Japanese ODA (Official Development Assistance).

Session 6.3

Business Applications

NOTES

An Advanced Private Digital Videotex System: HI-CAPTAIN

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ABSTRACT

NTT has been working to cultivate a new market for an advanced videotex system(HI-CAPTAIN) which can provide full-color pictures, graphics, and audio information from an information center to user terminals. This system can deliver more attractive services than conventional videotex service offerings by using a high speed digital communications network or ISDN.
This paper describes some actual applications of HI-CAPTIN combined with ISDN.

1. INTRODUCTION

The existing analog videotex system only provides visual information consisting of text and simple figures. Recently, demands for full-color picture and audio capabilities have been increasing especially in the travel and advertising industries. However, because of the analog system's low transmission speed, typically 4800 bits per second, full-color pictures can be displayed in only a small portion of the terminal screen or with rather poor resolution.

Meanwhile, an ISDN network went into service in Japan in 1988. An information retrieval service has been carried out in which multi-media information such as full-color pictures and audio information has been provided via this 64 kbps digital switched network. This service has involved the use of an advanced private digital videotexsystem, HI-CAPTAIN. (1)

HI-CAPTAIN is much more than just the digital equivalent of the present analog videotex, since it is able to utilize the many advantages that a digital network has to offer. The most important of these is speed. The fast, 64 kbps transmission speed that a digital system allows, combined with data compression techniques developed by NTT, achieves a significant reduction in display time of multi-media information. It can provide more attractive services than present videotex by capitalizing on this high speed capability. As a natural full-color videotex system, HI-CAPTAIN has been attracting more and more customers.

2. OUTLINE OF HI-CAPTAIN

2.1 FEATURES

HI-CAPTAIN has many superior functions over conventional videotex. Its major features are described below.

(1) Full-color pictures
The large number of colors available are effective for displaying an object realistically. A high compression coding scheme is used to transmit full-color pictures in about 10 seconds. Full-color pictures of actual objects or photographs can easily be created and updated by an input/editing terminal.

(2) Audio information
Audio information is used for narration and sound effects in addition to pictures. The provision of telephone quality voice can free a terminal user from the annoyance of having to read explanatory notes on the screen.

(3) Multi-media information
This system provides multi-media information such as text, graphics, full-color pictures and audio information. A user terminal can display them on the monitor screen with narration or background music. The system can also provide simple-animation frames. Table 1 shows the multi-media information provided via this system.

(4) Duplex communications service
Information can be input easily from different sources. Input of text, geometric graphics or full-color pictures is possible from not only from input/editing terminals but also user terminals equipped with input devices. This type of user terminal can transmit information to another user terminal.

2.2 SYSTEM CONFIGURATION

The configuration of the HI-CAPTAIN system is shown in Fig.1. It is composed of an information center, user terminals and input/editing terminals. User terminals and input/editing terminals are connected to the center through ISDN.

(1) Information center
The information center stores multi-media information. It sends requested information to the user terminal following receipt of a request for specific data, and also broadcasts commercially to user terminals. Two

Table 1 NULTI-MEDIA INFORMATION

Media	Description
Text	• Alphanumerics and Japanese kanji • 31 columns, 16 rows (normal size)
Graphics	• Photographic and geometric figures (lines, arcs, polygons, etc.) • Resoluti on: 496 by 384 dots
Full-color pictures	• Number of gray level:8 bits each for Red, Green and Blue • Resolution: 496 by 384 dots
Audio	• Voice & music: telephone quality • Melody: synthesized music

Table 2 SYSTEM SPECIFICATIONS

	small center model	standard center model
Transmission speed	64 kb/s duplex	
System response time	0.5 -- 1 sec.	
Display time	About 10 sec. for a full-color pictures	
Display resolution	496 x 408 dots	
Storage capacity (pages)	3,000	30,000
Number of simultaneously active lines	16	32

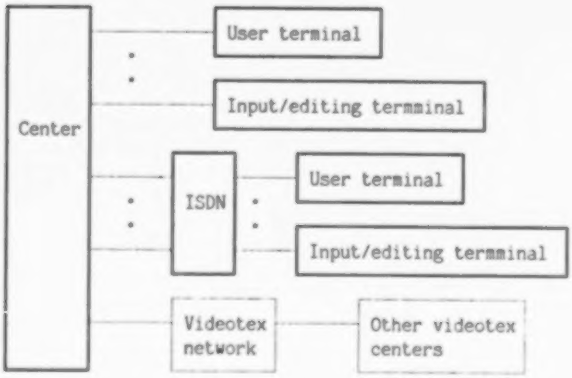


Figure 1 SYSTEM CONFIGURATION OF HI-CAPTAIN

types of centers have been developed which provide different page storage capacities and numbers of active connecting lines. The system specifications are listed in Table 2.

(2) User terminal
A user terminal(GT) is a kind of graphic terminal and reproduces various received data in real time. Three types of user terminals have been developed: (2)

A basic model(B-GT) can only reproduce received information. This model has an interface for connecting to an external controller such as a personal computer.

An advanced model(A-GT) is capable of inputting simple information including full-color pictures and sending it to the center in order to support a picture message board service. It also reproduces information received from the center. An A-GT consists of a B-GT and an external controller.

A storage model(S-GT) is another form of terminal combining a B-GT and an external controller. This model is capable of storing received information which is delivered by a multi-address delivery service from the center, in addition to reproducing it. After storing delivered information, the S-GT automatically disconnects a line and repeatedly displays the delivered information.

(3) Input/editing terminal
An input/editing terminal(IT) can be used to create and edit frames consisting of original text, graphics, full-color pictures and audio information. All information can be handled simultaneously by an IT. This terminal can also create and edit animation-like frames. (3)

Table 3 shows the various terminal types in this system with their functions.

2.3 SERVICE FUNCTIONS

HI-CAPTAIN provides five basic service functions.

(1) Information retrieval service
The center receives a request for information frames from a user terminal and retrieves the information in an interactive way. The retrieved information can thus be provided to the terminal within a reasonable time.

(2) Multi-address delivery service
The same information frames can be provided to multiple user terminals according to frame identifiers, delivery time, terminal address, etc., which are assigned via the center console or an input/editing terminal. The same information frames used in other services such as the information retrieval service can be used by designating the frame number.

(3) Picture message board service
An advanced user terminal model can read out and write information including full-color pictures. This information can be exchanged between user terminals via the memory at the center.

(4) Order entry service
The order entry service makes it possible for orders and reservations for goods and services to be accepted from a user terminal.

Table 3 TERMINAL TYPES

Terminal type	Functions	Devices
User terminal	———	———
Basic model (B-GT)	•Request and display •Auto receive	Touch screen
Advanced model (A-GT)	•(Basic model) •Create and transmit graphics and full-color pictures	Video camera, Digitizer
Storage model (S-GT)	•(Basic model) •Store received information	(None)
Input/editing terminal (IT)	•Create and transmit all information	Video camera, Keyboard, Mouse, Image reader, Audio coder/decoder

(5) Gateway service
Services of other analog videotex centers can be received by converting the transmission speed and communications protocol at the center.

3. ACTUAL SYSTEM APPLICATIONS

Some applications which have been implemented to date using the terminals mentioned above are described.

3.1 TOWN GUIDE SYSTEM

One HI-CAPTAIN system is operating in a shopping district on the west side of Yokohama station and serves as an information guide to shopping, leisure and entertainment events around the station. Through ISDN, this town guide system provided the same information at the site of an exibition being held near the station.

(1) System configuration
This system consists of a standard center, two ITs and 32 user terminal sets. Almost all of the user terminal sets incorporate two or three GTs. One GT is used only for picture delivery service. The other is used for retrieval service and message board service. The system configuration is shown in Fig.2.

(2) Method of use
Information is provided via the system in the following manner.
Guides to events or advertisements of shops are continuously displayed on user terminal sets by the multi-address delivery service. Further details about the displayed information can be obtained through the retrieval service.

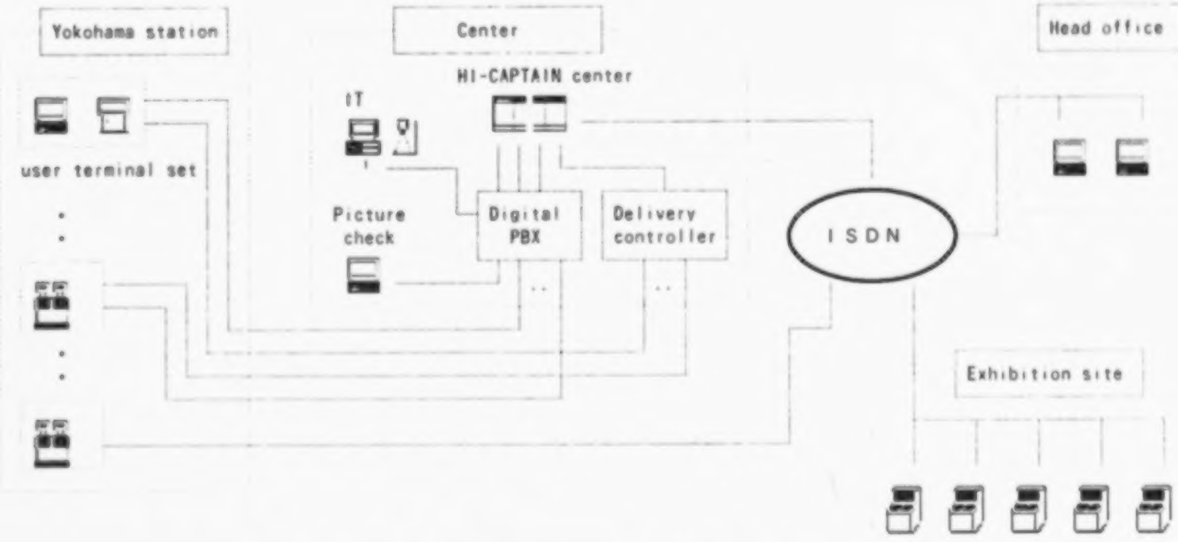


Figure 2 TOWN GUIDE SYSTEM CONFIGURATION

This system is intended to attract shoppers who are interested in the displayed information. Some of them will become interested in the system or information and access the center. The shopper will be able to get the desired information via the retrieval service as well as read from or write on the message board through menue inputs. The picture message board service also appeals especially to teenagers because of its easy operation and advanced mechanisms. They writes their own drawings and information freauently.

The number of stored frames has reached about 4,000 now, two years after the service started. The number of accessed frames is about 500,000 a month. Table 4 shows the types of information frequently accessed.

3.2 HOTEL SERVICE

Another system is employed widely in the western region of Japan using ISDN. The center and an IT are located in Osaka and GTs are installed in Kobe, a nearly port city, and Fukuoka, which is 500 km from Osaka.

(1) System configuration
In Kobe, an S-GT is placed in the lobby of a hotel built recently. Guides to famous shops and restaurants in the town are displayed on this terminal via the delivery service from the Osaka center. The same information is also delivered from the terminal to the TV sets in every room through a cable TV system. The system configuration is illustrated in Fig.3.

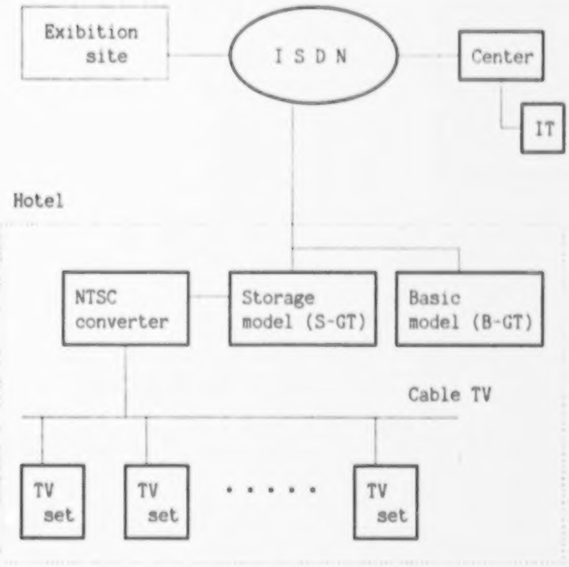


Figure 3 HOTEL DELIVERY SYSTEM

Table 4 ACCESS FREQUENCY

	Access frequency per month
Guides to events	about 100,000
Guides to restaurants	60,000
Guides to shopping	60,000
Requests for working students	40,000
Children's drawing contest	120,000

In Fukuoka, B-GTs and an A-GT are utilized for the Asia-Pacific Exibition in the same way as the above mentioned system.

(2) Present usage
This hotel service is mainly used for delivery service. Retrieval service is used by hotel staff to give visitors detailed information. The message board service is not being used.

At the exibition, the system is used in the same way that of shopping guide.

3.3 CONSUMER CONSULTATION SYSTEM

Another user has developed a new application of HI-CAPTAIN, a consumer consultation system for obtainig feedback from customers.

(1) Purpose
The user is a leading manufacturer of toiletary and daily commodities in Japan. The company has a section for accepting consumer opinions, requests or complaints by telephone concerning about six hundred kinds of products. The total number of calls handled is about forty thousand a year. When company operators talked to customers in the past, it was inconvenient because there was nowhere to stock all of the products near them. Thus, it was difficult to provide precise product information. The new consultation system can quickly display photographs or outlines of all the products on HI-CAPTAIN terminals.

This new system has solved the serious problem that all products could not be placed in front of the operators. Now, operators can quickly and easily get concrete pictures or text information related to the complaints or opinions expressed by consumers.

(2) System configuration
A user database has been utilized in the new system to facilitate easy and early implementation. The new system has been developed by combining a HI-CAPTAIN terminal(GT), which can display full-color pictures of products, and a workstation which is connected to the

user database system used before. The user database system is used in database management. Therefore, in this system an operator station or a user terminal set is constructed with a GT and a workstation. The configuration of the new system is shown in Fig.4.

The system components are a standard type of HI-CAPTAIN center, an IT, two databases, which had been used previously, and 15 user terminal sets, each of which is connected to the HI-CAPTAIN center and the databases. One database is located in the same area as the HI-CAPTAIN center in Tokyo and the other is in Osaka. The user terminal sets in Osaka are connected through the ISDN to the center in Tokyo.

(3) Method of use

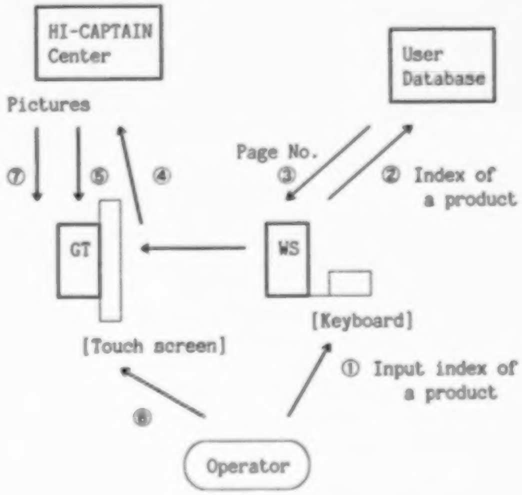
The operational flow is outlined in Fig.5. An operator inputs an index of a product from the workstation. The database converts it to the frame number for the workstation to control the GT for receiving the desired picture. In this way, the first frame for retrieval depends on the workstation and database, but after the first frame is received, the following operations are done only on the GT.

The retrieval service is the only service function used in this system. The user system and HI-CAPTAIN are presently connected by the workstation of the user system and the GT. New techniques for connecting the user center and HI-CAPTAIN center directly, such as by using another type of gateway service, will be used in the future to extend or upgrade the service.

4. SUMMARY

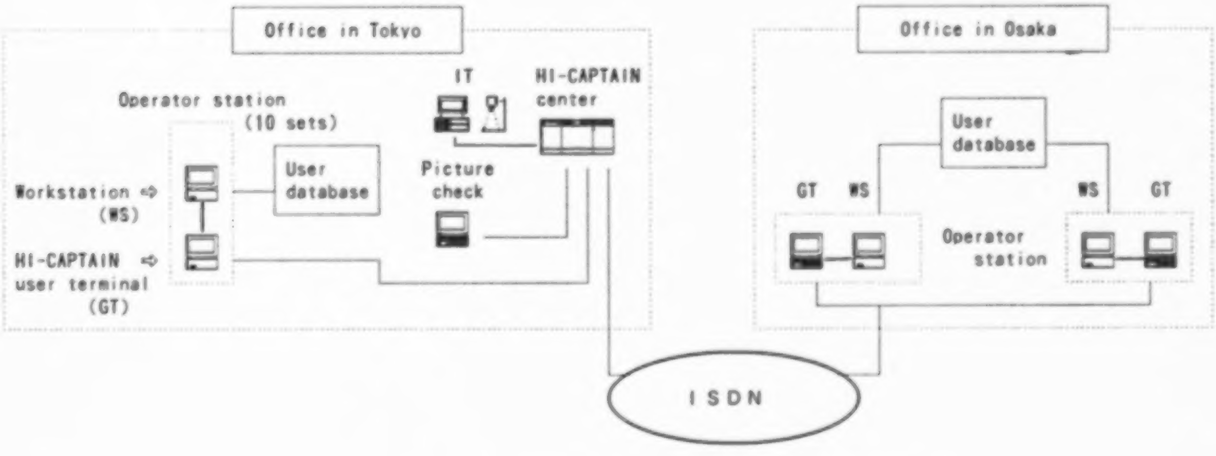
The HI-CAPTAIN system functions and actual services now in use via the systems described above are summarized in Table 5. The following conclusions can be drawn from the successful applications shown in this table.

(1) The information retrieval service and basic user terminal are common elements and will be instrumental in extending HI-CAPTAIN in the future.



HI-CAPTAIN Center
User Database
Pictures
Page No.
⑦
⑤
④
③
② Index of a product
GT
WS
[Touch screen]
[Keyboard]
① Input index of a product
⑥
Operator

Figure 5 OPERATIONAL FLOW



Office in Tokyo
Operator station
(10 sets)
Workstation ⇨
(WS)
HI-CAPTAIN ⇨
user terminal
(GT)
User database
IT
HI-CAPTAIN center
Picture check
Office in Osaka
User database
GT
WS
WS
GT
Operator station
ISDN

Figure 4 CONSUMER CONSULTATION SYSTEM CONFIGURATION

(2) In applications for many and unspecific persons, the multi-address delivery service will be effective in attracting them to the world of HI-CAPTAIN.

(3) The picture message board service will be very effective in expanding the user population of the system.

(4) In applications for the specific users or operators, HI-CAPTAIN should provide capabilities that help them to improve their own jobs or tasks. One easy and economical solution is to combine systems by connecting a HI-CAPTAIN GT and a terminal (or a workstation) of another system.

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(1) M. Arisawa, K. Ogura and S. Ishibashi: "Private Digital Videotex System," Review of the ECL, NTT, Jpn, Vol.36, No.1, 1988.

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Table 5 SYSTEM FUNCTIONS AND SERVICES IN USE

	Town Guide	Hotel Service	Consulting System
Information retrieval service	Very often used	Used as complementary function	Very often used
Multi-address delivery service	Very often used	Very often used	None
Picture message board service	Used	None	None
Order entry service	None	None	None
Gateway service (to other VTX)	None	None	None
Extended functions tions	None	None	Integrated system with other computers connected through GT

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INTERNATIONAL DIGITAL BUSINESS SERVICES VIA SATELLITE

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January 10, 1990

ABSTRACT

The first commercial International Business Service (IBS) circuit was placed in service in 1984. Initial Pacific Ocean Region (POR) service followed in 1986, and it has been a success story for INTELSAT and the participating Signatories. This paper will detail the experience with IBS; its growth and volume, its users and representative tariffs along with its applications. Now, with digital services available on fiber cables in the POR, what are the implications for the user in making the IBS-type services work for them. Finally, from a users perspective, we'll see how IBS is implemented from a planning to an operational stage; paying particular attention to a user's technical needs.

1.0 Introduction

There are numerous examples of inventions and technological advances that are still waiting to be implemented. Still others that are recycled in one fashion or another before they are acclaimed. IBS, or satellite digital business service is an application of technology in an industry that integrates innovation rapidly, that is both an opportunity for communications users and an idea whose time has come. IBS is the product of satellite technologists and marketeers. The engineers were able to provide digital circuits on satellites with superior performance (really since the mid-70's) and the marketeers rode the new wave of ISDN promise in the early 80's. When the two disciplines met, IBS was born, i.e. digital satellite service capable of providing private-network ISDN-like service with ISDN- like quality.

IBS is what the end-user wants it to be. It provides the user with time-of-day options, instant network reconfiguration of sorts, and most importantly a cost-effective means of communicating real time business needs.

Since its inception in 1984, International Business Service has experienced phenomenal growth. In 1988, IBS circuits realized an 80 percent worldwide growth, and IBS service between nations in the Pacific Basin grew by more than 170 percent.

We expect this growth to continue as both current COMSAT and INTELSAT forecasts indicate that IBS service will more than double by 1993. This will take IBS in the Pacific from 1,325 circuits to 2,997 by 1993. (See Figure 1.)

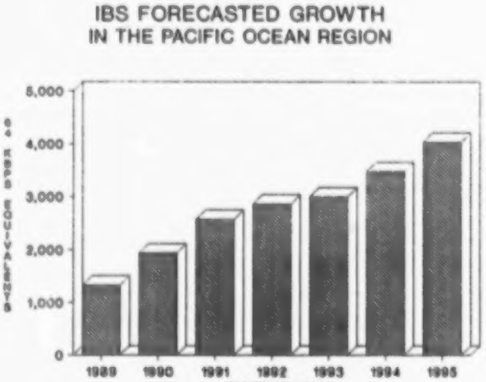

Figure 1

2.0 International Business Service

COMSAT's International Business Service is a completely digital private-line service that enables users to transmit and receive digital voice, data, and video signals via satellite. The space segment is offered for point-to-point and point-to-multipoint service in a wide range of speeds from 64 Kbps to 768 Kbps, and at 1.544 Mbps, 2.048 Mbps, and up to 8.448 Mbps. IBS is also available in simplex, half-duplex and full duplex transmission modes, and at fractional transponder capacities from 9 MHz to 72 MHz.

Non-Preemptible service is ordered by the customer on the following basis:

°Full-time	24 hours a day, seven days a week.
°Part-time	Seven days a week, beginning and ending at the same time each day.
°Occasional-Use	As needed, with 24 hour advance reservation. Part-time and Occasional Use periods include standard (1200-2000 hours GMT) and Economy (2000-1200 hours GMT) rates.
°Multi-Year Contract Service	Full-time service leases for 3,5 and 7-year contract terms at significantly reduced rates.

2.1 Network Flexibility

The IBS service can be used for data only transmission, voice/data transmission, alternate voice/data transmission and videoconferencing; allowing customers great flexibility in terms of network service utilization with ample bandwidth for integrated networks with mixed high-volume voice, data and video requirements.

In Figure 2 below, this mixed use of a private integrated network is illustrated. A single T-1 (1.544 Mbps) is used simultaneously for carrying low-speed data, batch data and electronic mail, as well as videoconferencing, e.g. between the U.S. and Singapore. Not only can the circuit utilization be dynamically allocated between services, it can be routed between two points or connect several points in the Pacific.

INTEGRATED PRIVATE NETWORK
BETWEEN U.S. AND SINGAPORE

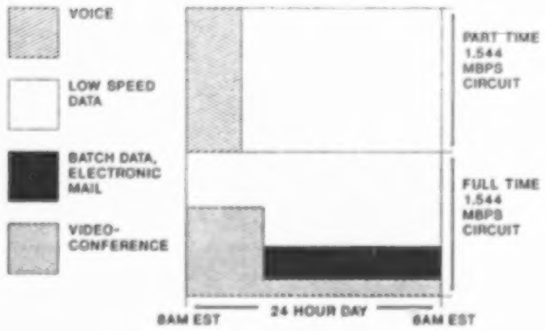

Figure 2

While an alternate voice and data (AVD) leased channel also allows a degree of user flexibility, an AVD does not provide video signals, and AVD's are not available in the bandwidths required for a growing number of multinational users.

Fiber cables do provide a viable alternative in terms of typically required bandwidth and service integration, however, cables fail to provide true global connectivity by not accessing many of the smaller areas of the Pacific. Cables also do not provide economical point-to-multipoint flexibility.

COMSAT's IBS and other voice, data and video IBS satellite services are insensitive to distance and geography, and therein exists their greatest competitive advantage in the Pacific Basin.

2.2 Cost Competitiveness

Several factors contribute to IBS's cost competitiveness in the Pacific region. IBS's insentivity to distance and geography has already been addressed, however, this factor is especially critical in the Pacific. Depending upon the application, IBS by satellite will be the only option available or will continue to be cost-competitive on the high traffic point -to-point routes, such as U.S. to Japan when compared to Pacific cables like HAW 4/TPC-3. Moreover, for a large and growing multinational corporation operating in the Pacific, the cables will leave the greater part of the region unserved.

IBS will remain cheaper for point-to-multipoint traffic. This again is largely due to the great distances involved.

Another factor in IBS's cost-competitiveness is the fact that IBS is well-suited for use with smaller, less costly earth stations. Customers can use earth station as small as 3.5 meters in Ku-band and 4.5 meters in C-band.

These factors combined with the fact that earth station access charges as well as satellite circuit costs have been steadily decreasing, continue to make IBS a most cost-effective means for international communications in the Pacific.

2.3 Quality and Reliability

IBS's all digital transmission provides for better data transmission than traditional analog lines. This provides customers with not only much lower bit error rates, but also simplifies data encryption and other value-added services. Combine this superior quality with the INTELSAT network's reliability and you are ensuring the clear and dependable communications that not even the fiber cables have yet achieved.

IBS attains a bit error rate of $1x10^{-8}$ or better with 1/2 FEC under clear sky conditions, and $1x10^{-6}$ or better with 1/2 FEC assuming degraded sky conditions. Since 1984, IBS has had a service continuity record of 99.9 percent or better.

In 1987, reported failures on the Trans-Pacific-1 and Anzcan cables interrupted service for twenty-five days on 172 circuits. Cable breaks on the Hawaii-2 cable caused outages for 19 days and 278 circuits. Between 1986 and 1988, cable failures and planned interruptions in both the Atlantic and Pacific accounted for 460 days of interrupted use on 22,324 circuits. While some of these restorations and planned interruptions were continued via other cable systems, the majority were restored by the Intelsat satellites.

2.4 User Profiles and Applications

Due to the high volume capabilities of the IBS service, IBS is ideal for international communications from the largest industry players to the smallest niche player. Some of the major industry subscribers for IBS services include:

- °Publishing/Printing
- °Petroleum/Energy
- °Banking/Financial
- °Manufacturing
- °Government
- °Service Delivery
- °Airlines/Transportation

Typical IBS applications include the following:

- °Wideband Private Line
- °Digital Voice
- °High and Low Speed Data
- °Videoconferencing
- °Audioconferencing
- °Slow Scan Video
- °Electronic Funds Transfer
- °Credit Verfications/Authorization
- °Digital Facsimile
- °Remote Printing
- °Corporate Communications
- °Corporate Training
- °Computer-to-Computer Communications
- °Distributed Data Processing
- °Telephone Services
- °Electronic Mail/Electronic Data Interchange
- °On-Line Transaction Processing
- °ISDN

As was mentioned in section 2.1, private dedicated international networks can be designed to facilitate any combination of these operations, between two points or from one point to several locations.

Let's take a look at three specific examples of how IBS could provide solutions to a particular customers needs.

3.0 Three IBS Application Solutions

COMSAT's IBS service can handle virtually any communications requirement a business user might have, and with advances in wideband satellite technology, IBS has become increasingly economical. Newer technologies make it possible to locate small dish-type antennas close to customer premises, eliminating the need for expensive land lines and reducing the overall circuit costs.

3.1 High-Speed Data and Business TV

A San Francisco based investment house routinely needs to transmit high volumes of financial data to and from its headquarters mainframe computer to a host computer in its Tokyo office. The brokers and traders will work feverishly anticipating the opening of the Tokyo exchange at 3 p.m. PST. The computers link the commodities, options and market indexes as well as enable the processing of transactions and portfolio analysis. The investment house also uses the business television capabilities to relay government reports and announcements as they are broadcast in Tokyo and to monitor response on the Tokyo Exchange floor. Considering the extremely large amounts of financial data involved and the need for television connections, a T-1 circuit will be needed. An alternate voice/data (AVD) circuit will not provide the required bandwidth, and analog circuits will also not work because of the need for integrated services on a mixed-use basis. Cable could handle the application if available, but if the same data disseminating from San Francisco needed to go to several offices trading in the Pacific, an IBS circuit would have a clear operational advantage. (See Figure 3.)

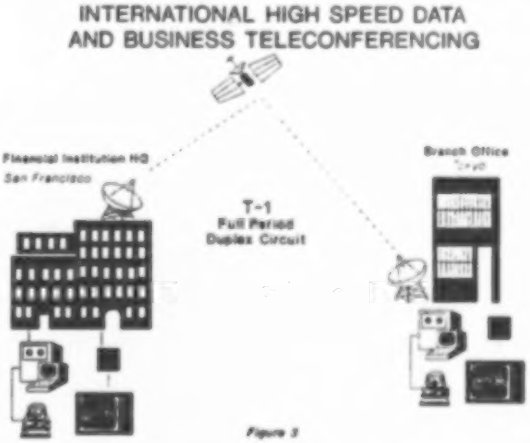

Figure 3

Large investments ride on this connection; a secure, reliable, and accurate communications path is mandatory. This is IBS's forte.

Other examples of this type of service combination include large U.S. multinationals needing to communicate with office, operating and manufacturing facilities offshore. Reuters employs a similar type of satellite network which links more than 170,000 terminals in 120 countries. More than 470 private lines connect customers to its three main computer centers in Hong Kong, London, and Hauppauge, NY. Reuters Holdings Plc. has developed into the world's leading supplier of computerized information using high-powered satellites to distribute its publications and financial information to small-dish antennas.

3.2 Remote Location Printing

The bureau chiefs in both the Philippine and Hong Kong offices are working against print deadlines as they assemble stories including text, layouts, graphics and photos for the International edition of a large Los Angeles based daily newspaper. Using an on-premise, international earth station at headquarters, and a high-speed all digital link, Hong Kong and the Philippines use digital facsimile to reproduce the pieces in the Los Angeles' communication room. Assembly and final editing are completed and the final form is transmitted at 10 a.m. PST, so that the paper is printing in Hong Kong and the Philippines just after 2 a.m. Local distribution by truck and by air is done as papers are on the doorsteps by 6 a.m. The transmittal of the paper requires a full duplex 256 Mbps digital circuit, again with speed and service capabilities that an AVD circuit could not provide.

A cable circuit could provide similar services and benefits to the publisher, but because of the multiple remote print sites used for widespread distribution - fiber cables could not provide the same coverage as economically. (See Figure 4.)

INTERNATIONAL REMOTE PRINTING FOR PACIFIC REGION DISTRIBUTION

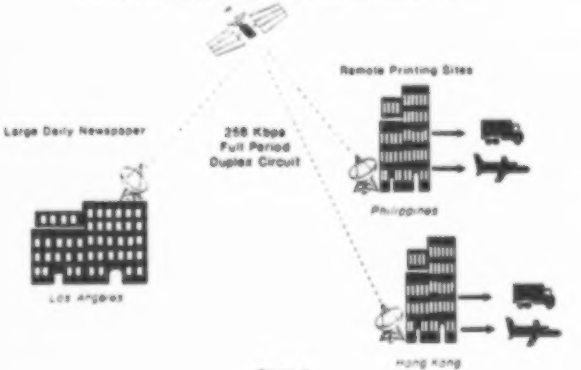

Figure 4

Printing in remote locations allows the Los Angeles paper to save significantly on distribution costs, while also allowing the newspaper to assemble and produce an information product in a timely manner.

Several international daily papers operate using remote print and distribution centers, including the Wall Street Journal, Financial Times and USA Today International. USA Today International operates on the INTELSAT satellite network, and the paper was first printed via satellite in Singapore on October 8, 1985 and in Hong Kong in April 19, 1988.

3.3 Voice, Facsimile and Slow-Scan Video

An Engineering Product Manager at a large international manufacturer of computer-aided design, semi-custom microchips is on the phone with a customer in Phoenix. The customer is working with the Seattle chipmaker trying to determine a solution to a problem on a new fully automated production line. The timing is off on one of the front-end assemblers; it is determined that the problem cannot be resolved by modifying the software. The chip design will have to be modified. The Seattle engineering team work all night on the design change determining parameters and performance tolerances for the new timing. The offshore facility's Production Manager in Singapore is notified via facsimile and conference calls of the modified design. The Seattle headquarters uses slow-scan video to relay the new schematic diagram for photographic reproduction. The Singapore shop has a three day turnaround to get the prototype back to Seattle for testing. By the end of the week if all goes right, the Phoenix manufacturer will be ready to install the new custom chip. The Seattle chipmaker uses a private, all digital network between headquarters and the offshore production facilities, and because of the low traffic, only one 64 Kbps duplex circuit is needed to connect the two facilities.

IBS service provides the only all digital solution presently available linking Singapore and the U.S. West Coast. (See Figure 5.)

INTEGRATED PRIVATE NETWORK FOR TELEPHONE, FACSIMILE AND SLOW-SCAN VIDEO

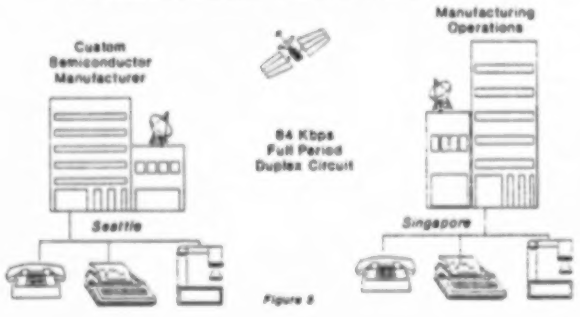

Figure 5

INTELSAT OPERATIONAL ORGANIZATION

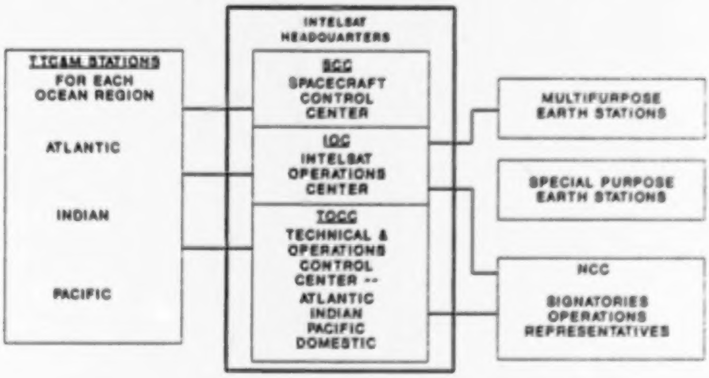
INTELSAT HEADQUARTERS
TTC&M STATIONS FOR EACH OCEAN REGION
ATLANTIC
INDIAN
PACIFIC
SCC SPACECRAFT CONTROL CENTER
IOC INTELSAT OPERATIONS CENTER
TOCC TECHNICAL & OPERATIONS CONTROL CENTER -- ATLANTIC INDIAN PACIFIC DOMESTIC
MULTIPURPOSE EARTH STATIONS
SPECIAL PURPOSE EARTH STATIONS
NCC
SIGNATORIES OPERATIONS REPRESENTATIVES

Figure 6

4.0 Comsat Network Services

The following information will not only detail the complete process for initiating and ordering new COMSAT IBS service, but will also describe some of the INTELSAT/COMSAT network management and operations processes that support the IBS service.

COMSAT's network control management provides a continuous source of information for the customer and reduces the customers need for redundant control and management facilities. Through our enhanced network services, user control is improved for management of performance and costs. This helps our customers optimize use of their resources.

Through the use of a world wide network of Tracking, Telemetry, Command and Monitors (TTC&M) stations and Communication Systems Monitors (CSM), INTELSAT maintains overall system management with the signatories and the earth stations under their jurisdiction. The network management hub is provided by the INTELSAT Operations Center (IOC) which is manned on a 24-hour basis. The IOC maintains Engineering Service Circuits (ESC) with all monitoring stations as well as the multipurpose earth stations.

In addition to the INTELSAT system management network, signatories through their operations representatives maintain Network Coordination Centers (NCC). As the U.S. Signatory and U.S. Operations Representative to INTELSAT, COMSAT serves U.S. earth Station operators by providing space segment, operational planning and procedural information. Prior to activation, applications for verification are arranged and assistance provided. Space segment monitoring, control and network maintenance services are provided once an earth station is activated.

A 24-hour point of contact is provided to clear space segment problems and for other technical and operational matters. This is the COMSAT NCC (Network Coordination Center).

The relationship between INTELSAT, the signatory COMSAT and the earth station operators is set forth in the INTELSAT Operating Agreement. Figure 6 above provides a graphic display of this relationship.

Through the use of the COMSAT operations and Network Coordination Centers, COMSAT's 24-hour point of contact serves all IBS user earth station antennas whether manned, partially manned, or unmanned (remote controlled).

4.1 Initating IBS Service

Figure 7 below describes the process for initiation of international service. This table includes the steps which are to be taken on both the owners behalf and by COMSAT ISS.

IBS NETWORK MANAGEMENT SERVICES

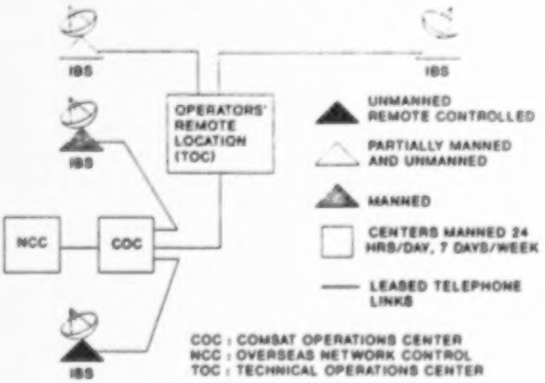
IBS
IBS
OPERATORS' REMOTE LOCATION (TOC)
IBS
UNMANNED REMOTE CONTROLLED
PARTIALLY MANNED AND UNMANNED
MANNED
CENTERS MANNED 24 HRS/DAY, 7 DAYS/WEEK
LEASED TELEPHONE LINKS
NCC
COC
IBS
COC : COMSAT OPERATIONS CENTER
NCC : OVERSEAS NETWORK CONTROL
TOC : TECHNICAL OPERATIONS CENTER

Figure 7

The prospective owner should notify COMSAT ISS, as far in advance as possible, of plans to operate an earth station. Notice should include proposed location, type of station, intended date of completion, antenna type, type(s) of service and service date(s). This information will be incorporated into an operational plan which details the integration of each user's requirements into the INTELSAT network. ALL FCC licensing, approvals, etc., remain the responsibility of the potential earth station owner.

As soon as the earth station's exact location and technical specifications have been determined, the owner should submit an application for approval to access the space segment to COMSAT ISS.

COMSAT ISS will review completed earth station applications to ensure INTELSAT standards are met. Once this has been done, approval will be granted to the earth station owner for access to the space segment.

The owner should advise COMSAT ISS of any subsequent change in the service date(s) to allow for update of operational plans.

The owner informs COMSAT ISS of readiness to access a satellite for antenna verification tests along with a request for access to the INTELSAT space segment and CSM support if required. COMSAT ISS provides approval to access, arranges for verification tests, forwards a test plan to the owner, provides appropriate satellite orbital elements or antenna pointing data as required, and provides an earth station identifier.

The owner then performs earth station acceptance and verification tests to confirm that the station meets performance standards prior to accessing the satellite.

COMSAT ISS schedules and coordinates verification tests. The owner then forwards verification test data to COMSAT ISS. COMSAT ISS reviews this data and upon determination that all tests results are satisfactory, certifies this to INTELSAT.

COMSAT ISS provides the owner a copy of SSOG test plan(s) and schedule for satellite access time for initial line-up tests and coordinates the commencement and conduct of these tests. Test results are forwarded by the owner to COMSAT ISS as soon as possible following the test. Upon notification by the owner and confirmation by COMSAT ISS of satisfactory test completion results, approval will be provided to commence service.

After all tests have been performed and the results have been reviewed, COMSAT ISS will grant provisional approval to commence operation. Final approval is normally granted after a comprehensive review of the test data. A final test report is required within 30 days of the conclusion of the antenna verification tests.

4.2 Ordering Service

The following outlines briefly the process for adding to or modifying existing full period or occasional use services.

The earth station owner remains responsible for obtaining necessary FCC authorization and agreements with the overseas entities when adding new services or modifying existing services. Once these arrangements are concluded, the submission of the new Service Request to COMSAT ISS should be accomplished. (Upon receipt of a matching order from the overseas entity, satellite assignments will be made).

The earth station owner or operator forwards to COMSAT ISS a Service Request containing specific information about new or modified services.

COMSAT ISS provides the earth station owner or operator with an SSOG test schedule including date, time and type of tests to be conducted. Every effort shall be made to arrange for the test time that is desired by the earth station owner/operator as stated in the Service Request.

Upon notification by the earth station owner or operator, COMSAT ISS coordinates testing.

Upon completion, test results are forward by the operator to COMSAT ISS for review.

Upon satisfactory completion of all tests, COMSAT ISS will provide approval to commence service operation. This may be provided verbally and will always be followed by written notification.

5.0 Conclusion

Looking forward, COMSAT recognizes the changes that are taking place in international communications and in the Pacific. Traditional communications of the past have given way to the new opportunities available through cost-effective private satellite and fiber optic networks.

This broad impetus towards the establishment of worldwide digital networks is highlighting the fact that the two complementary technologies of satellite and cable are becoming increasingly important in accommodating the magnitude and scope of communications demanded.

While some proponents of fiber cable have predicted declining rates for international satellite usage for the mid-1990's, the dramatic growth in international communications will ensure ample business for both satellite and fiber cables, and foster an environment for some degree of guaranteed coexistence.

COMSAT witnessed this demand firsthand at its annual global forecast meeting this past May. When the major U.S. international service carriers and 145 INTELSAT member countries joined to set forth their requirements over the next 5 to 15 years. As demonstrated in Figure 8 below, IBS in the Pacific will not only experience very strong growth, but a growing regional percentage of total IBS as well.

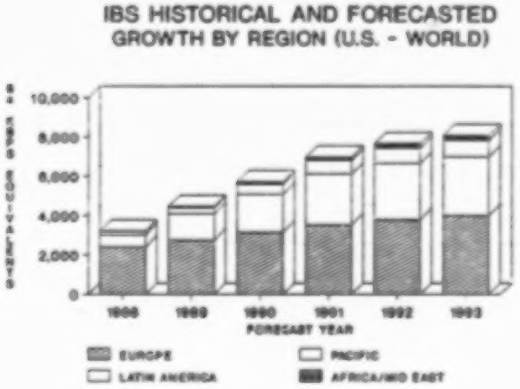

Figure 8

The Pacific region which now accounts for 30% of total IBS traffic is forecasted to become over 37% of total by 1993, at a forecasted annual growth rate of approximately 25%. At this growth rate IBS is expected to triple in the next five years. These carrier forecasts which have taken cable growth into consideration, are very encouraging to us. They validate the longstanding and continuing commitment COMSAT has made to the communications of the Pacific.

This commitment includes our involvement in many international communications projects within the region, including the launch of a new satellite series to replace existing INTELSAT satellites currently operating in the region. Our goal is to have two INTELSAT VII's operating by January 1992. These two new satellites will offer increased Ku-Band coverage, and higher satellite power, which will enable greater use of the smaller and lower cost earth stations for IBS.

This increased capability will benefit new carriers and private network customers, who will find the ability to locate smaller antennas closer to their operations site a great cost advantage.

In summary, given the inherent features of satellites and IBS, especially in the Pacific region which include:

- Cost Competitiveness
- Insensitivity to Distance and Geography
- True Global Connectivity
- Point-To-Multipoint Advantages
- Very Large Bandwidths
- Integrated Network Flexibility
- Superior Quality
- Unparalleled Reliability
- Greater Network Control/Optimization

it is easy to understand how IBS can provide cost-effective private network solutions for your growing companies needs.

6.0 Contact Information

We at COMSAT welcome the opportunity to discuss your international communications needs.

If you would like more information on how our IBS service can accomplish your communications goals, please contact a member of our ISS Sales team at the following phone numbers and address:

°Joel Allen - Director, Carrier and
Corporate Accounts
COMSAT WSD (202) 863-6295

°John Kopinski - Director, Sales Support
COMSAT WSD (202) 863-6253

°Steve Carroll - Vice President, ISS Sales
COMSAT WSD (202) 863-6237

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Office Planning Using an AI System for Telecommunications

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1. ABSTRACT

Although telecommunications are widely used in current business office environments, office floor planning, one type of office facility management (FM), does not consider the installation telecommunications equipment and terminals. Fujitsu has developed an office planning and management system called OFFICE EXPERT to support office planning and management for efficient telecommunication in the office. This paper introduces a system overview and future development steps.

2. OFFICE PLANNING ISSUES

Many types of communications equipment and terminals are installed in the business office. To ensure efficient and adequate office telecommunications planning, the issues below must be fully considered.

(1) Less wiring capacity in duct

The building's vertical electrical pipe shaft (EPS) carries power and telecommunications cabling to each floor, and communications equipment and terminals on each floor are connected to the EPS via underfloor cabling ducts and raceways.
However, current planning or management of cabling and duct capacity is insufficient for telecommunications equipment. When a terminal's position must be changed and duct capacity is insufficient due to node position or cable size, cabling cannnot be routed within the duct and therefore must be laid on the floor. Such exposed cabling is insecure, potentially dangerous, as well as unsightly.

(2) Insufficient supplied power

It is difficult to know at the planning stage whether the power supplied to each floor will be sufficient to handle future equipment changes or addition of equipment. Therefore, some means of planning for potential changes is needed.

(3) Equipment heat dissipation

The air conditioning and ventilation systems must be designed to handle the heat generated by the office equipment. A floor plan drawing including equipment locations and the amount of dissipated heat is needed to enable users to study the designed layout before determination.

3. OFFICE EXPERT OVERVIEW

The OFFICE EXPERT is an expert system software package designed for personal computers. This package combines artificial intelligence (AI) and computer aided design (CAD).
The OFFICE EXPERT system automatically generates a floor layout based on furniture, equipment, and the number of employees. The OFFICE EXPERT also generates a power and telecommunications equipment cabling layout. The system then checks duct capacity and power consumption. AI enables arrangement of floor layout based on the input data and CAD enables output of the floor-layout diagram.
Hardware and software for the system is described below.

- Hardware: FMR 70 (32-bit personal computer manufactured by Fujitsu)
- Software: GCLISP for AI (manufactured by Gold Hill Computer)
  FCAD-R for CAD (manufactured by Fujitsu)

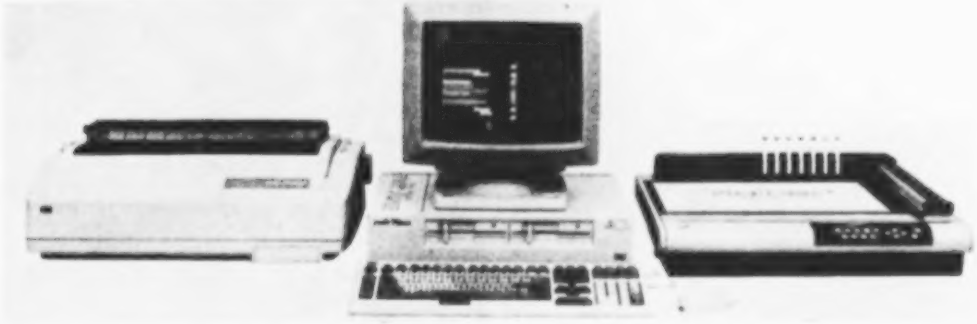

Figure 1 Hardware configuration

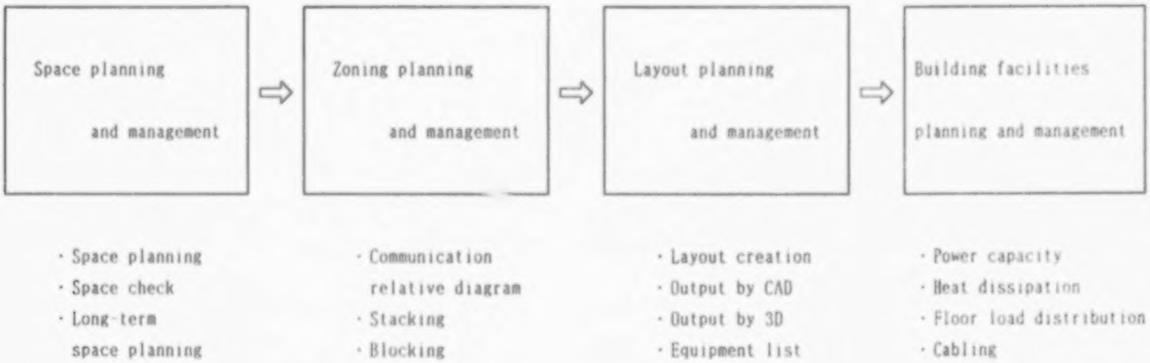
Space planning and management
Zoning planning and management
Layout planning and management
Building facilities planning and management
· Space planning
· Space check
· Long-term space planning
· Communication relative diagram
· Stacking
· Blocking
· Layout creation
· Output by CAD
· Output by 3D
· Equipment list
· Power capacity
· Heat dissipation
· Floor load distribution
· Cabling

Figure 2 System processing flow chart

Figure 1 shows the hardware configuration. The OFFICE EXPERT system consists of an MPU, CRT display, keyboard, mouse, printer, and XY plotter.

Figure 2 shows the system processing flow chart. System processing is carried out in the 4 steps described below.

(1) Space planning and management

The system calculates the space required for the office based on personnel organization input data and checks whether the specified floor space meets the requirement. There are space standards for furniture and equipment. Also the system enables display of graphics, including the number of employees and space change for each year.

(2) Zoning planning and management

A relative diagram is displayed by inputting communications connections for each organization. Each organization are automatically assigned each floor and office based on communications connections. Personnel are then assigned to blocks on each office. Also user enables change that assignation.

(3) Layout planning and management

The system automatically generates a layout for personnel, furniture, and equipment for each floor, based on the input data floor space and layout rules. There are several office layouts for furniture and equipment: back-to-back, all facing the same direction, and hexagonal type.
The layout arranged using AI can be added or modified using CAD. The system then generates and displays a color perspective drawing using CAD. In addition, a list of equipment and furniture can be displayed.

(4) Building facilities planning and management

The system checks whether the building's power capacity is adequate and displays the heat dissipation and floor load distribution. The system automatically generates a cabling layout and checks the duct capacity.

The OFFICE EXPERT system provides the four features for telecommunications described below.

(1) Cabling simulation

Cabling routes for power and telecommunications lines are generated based on the equipment layout. If the equipment location is changed, this cabling simulation allows users to find the best cabling route.
The system generates the best cabling layout in which cabling is kept as short as possible with no exposed cables. For telecommunications lines, the cable type (power, coaxial, or optical fiber cable) can be selected.
Figure 3 shows a cabling diagram generated by the OFFICE EXPERT system.
The diagram was output using CAD. The floor plan, layout of furniture and terminals, and power supply cabling are included in Figure 3. A telecommunications cabling diagram can also be displayed. Building, furniture, and power and telecommunications line data is stored in individual CAD layers. The desired data can be displayed on the screen by selecting a layer.

(2) Checking available duct space

The system automatically generates a layout for power and telecommunications lines. Cables for each line are wired in individual ducts. The system calculates the percentage of duct space in use and displays the calculated used duct space. The percentage of duct space in use means the percentage of the duct cross section that is occupied by cables. Based on the calculated percentage, the system outputs a message to the screen to indicate whether a duct has available space. The percentage of duct line space in use can be displayed on the screen by selecting the desired data stored in the CAD layer and specifying the desired line on the screen using a mouse.

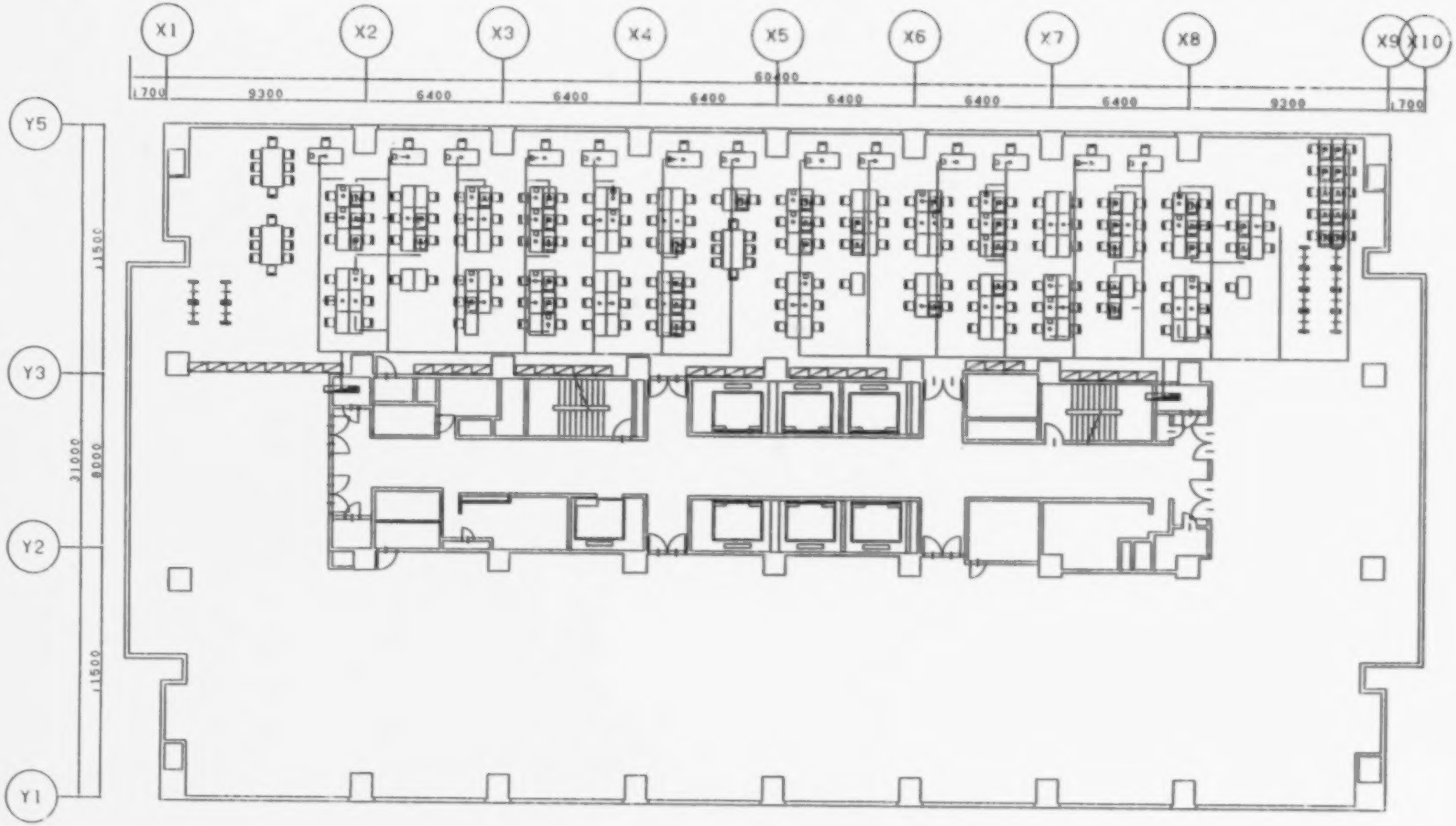
X1
X2
X3
X4
X5
X6
X7
X8
X9
X10
60400
1700
9300
6400
6400
6400
6400
6400
6400
9300
1700
Y5
Y3
Y2
Y1
11500
8000
11500
31000

Figure 3 Cabling diagram

(3) Checking power capacity

The system checks whether the power facilities for each floor are adequate by comparing the power supplied to each floor to the total power consumed by all the office equipment on that floor. This enables the user to know the power supply conditions even for offices in which the floor layout is frequently changed, and allows the user to modify the building's power distribution board after a floor layout change. The cabling route for the power supply can also be checked based on power capacity.

(4) Displaying dissipated heat distribution

For air conditioning and ventilation, the heat dissipated by the equipment installed in the office must be known, taking the possibility of equipment layout change into consideration. This system displays the distribution of heat dissipated by the equipment overlaid on the equipment layout plan.

Figure 4 shows the screen display of the dissipated heat distribution. Black portions at the right indicate locations where heat dissipation is high (these portions are actually displayed in color). This helps the planner to design the appropriate individual or overall air conditioning and ventilation systems.

The OFFICE EXPERT system provides the above features and can simulate various cabling and ventilation schemes. These simulations allow users to determine at the planning stage whether building facilities meet the requirements for telecommunications equipment layout. When various layout plans are necessary, these cabling and ventilation simulations can, reduce the time needed for office planning.

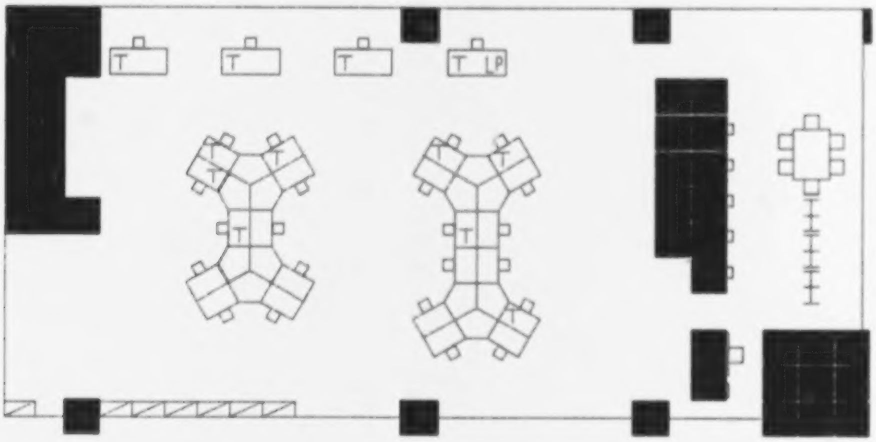

Figure 4 Heat dissipation distribution

4. FUTURE STEPS

Our OFFICE EXPERT system was designed to help eliminate planning problems posed by telecommunications equipment. We hope to improve the OFFICE EXPERT system as follows:

(1) Lighting layout to eliminate display reflection

Office lighting must be fully considered to enhance display visibility. A simulation of lighting conditions (overhead lighting, window locations, and display locations) would help to determine the best overhead lighting arrangement or display locations.

(2) Printer noise consideration

Because it is difficult at the planning stage to generate an office layout which considers printer noise, noise prevention is considered after printers are installed. The office environment can be improved by isolating such noise in the floor. Simulation of sound source distribution and partition positions is also necessary.

(3) Telecommunications system design

For application of a local area network, we hope the system enables consider nodes and cabling method based on the cables (power supply, coaxial or optical cable), the traffic volume and the type of medium (data, voice, or image) used.

5. SUMMARY

The OFFICE EXPERT system reduces the time needed for accurate office layout planning and management. Further developments of this system will help to design offices which are ergonomic and highly information oriented. Fujitsu, as a major communications equipment supplier, will continue to supply more efficient systems for the improvement of office planning and management and which will be able to handle expanded telecommunications applications.

This OFFICE EXPERT system, which is now under examination, is scheduled for general use beginning in April.

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Session 6.4

Telework

NOTES

The telework suitability scale: Developing common expectations among supervisors and teleworkers for location-independent work

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1. Abstract

Computer-based work from home is only one of many technology-location pairings (e.g. cellular phone-car) that has evolved to accelerate the pace of work. As work and personal environments increasingly overlap, new policies concerning how, when and where to work must be developed that are satisfactory to both workers and their supervisors. This paper presents a *telework suitability scale*. It is designed to help management and teleworkers establish common expectations of location-independent work as they negotiate policy to manage this emerging innovation.

2. INTRODUCTION

Teleworking is a term often associated with working from home and using computer support systems to accomplish home-based work. It is somewhat difficult to trace the historical reasons for the emphasis on the home as the distant workplace and the computer as the enabling technology. The focus on the home may reflect the early work of Jack Nilles (1976) in which, while addressing needed alternatives to single occupant automobile travel, he discussed working at home as a substitute for travel to a central office. The pivotal importance ascribed to the computer in discussing telework probably reflects the computer's central role in the information industries now purportedly employing over 60 percent of the workforce (Gordon & Peterson, 1989).

3. TELEWORK: CAUSE FOR EXCITEMENT OR ALARM?

Thinking of telework as work from home using computers excites and alarms various groups. For example:

Labor Unions are alarmed: "RESOLVED, That the AFL-CIO calls for an early ban on computer homework by the Department of Labor as a measure of protection for those workers entering the market for the fastest-growing occupation in the United States." (a 1983 resolution of the AFL-CIO cited in Olson, 1985, p. 153).

Telecommunication manufacturers are excited: the home market is an important slice of the "explosive" 600 billion dollar a year equipment market.

Futurists, represented by Alvin Toffler (1980) mostly are excited: "transferring less than one-fifth of the workforce to home-based work would find "our entire economy, our cities, our ecology, our family structure, our values, and even our politics altered almost beyond our recognition" (p. 207).

Phone companies are both alarmed and excited, because extensive data traffic affects rate of service (cause for alarm) and argues for a surcharge on data traffic transported over the public voice network or expansion of packet switched services (causes for excitement).

While the home *is* an important distant work location and the computer *is* an important enabling technology of telework, in this paper we will argue that neither is central to the growth of *work performed at a distance* [the definition of telework we prefer]. Rather, the dominant reason for the growth in work performed via computer from home is that competition continues to accelerate the pace of work. Indeed, the union of the home and the computer is just another facet of a work process now emphasizing "just-in-time manufacturing" (Jaikumar, 1986), "just-in-time documentation" (Acker, 1989), and "instantaneous iteration" in the design-marketing cycle for new products (Hiatt, 1989). In other words, computer-based work from home is a *member of a set of location-technology groupings that permit work to be accomplished flexibly and quickly*. This increased emphasis on timeliness is expanding the amount of work being done in environments that traditionally have not been as closely associated with accomplishing work.

Technological groupings designed to accelerate the work process include the "on-the-road" salesperson and his/her cellular car phone, the pager and the utility meter reader's footpath, the skyphone and the executive's first-class aisle seat, and the Open University student and his/her television set. In less hurried eras, the car was not a "mobile office," the sidewalk was not a data entry corridor, the airplane was not a node on a work-based telecommunications network, and the living room was not a place to be paced by a television set toward a college degree. Instead, each of these locations represented personal space, much less at the beck and call of an interactive work environment.

Although individuals have always worked outside of a core office setting (e.g. farmers, university faculty, manufacturer representatives), as the phenomenon spreads into traditionally office-based work personnel, the effect on how, when and where to work becomes of concern. In general, both supervisors and workers in this work domain are not experienced at conceptually "melding" work and personal space. Instead, many are remarkably adept at segregating their workspace and their personal space. Indeed, the opportunity to exhibit different personalities in different locations may offer a central stress-coping mechanism for many office-based personnel.

Becker (1981) contends that the capacity to maintain a distinction between personal space and workspace is important for many aspects of emotional and mental health. If the home as a "retreat" does not stand against the demands to rapidly (or flexibly) accomplish work, workers and supervisors who enter into agreements that blur the distinctions between work and personal space may face unanticipated problems in adapting to the new work situation.

We agree with Forester (1988) that the work-from-home form of telework is still in its infancy (his position further suggests it will be a long time in maturing). He argues that the slow growth represents unresolved, and perhaps unresolvable, problems for the teleworker. We, on the other hand, feel the impediment is more the *unexplored expectations of both teleworkers and their managers* and their common lack of experience at anticipating the effects of overlapping work and personal space.

The novelty of organization-based telework encourages institutional inertia to confine work locations to the central office. Further, the likelihood of disillusionment from telework pilot projects will remain high until the management models are established in both the worker's and manager's minds for work performed at home. Therefore, to summarize on the theme of this section of the paper, *whether location-independent work should alarm or excite depends on the capability of employers and teleworkers to manage both work and personal activity when space does not intrinsically separate the two activity domains*.

4. DEVELOPING A TELEWORK MANAGEMENT MODEL

In this paper our goal is to further the development of management models for telework begun by such authors as Gordon and Kelly (1986), Olson (1985), and Shirley, (cf Kinsman, 1987). While these authors have concentrated on such important issues as worker selection processes, remuneration schemes, output-based assessment procedures, and policies for effective communication, our approach is concerned with identifying, and conforming, the expectations that teleworkers and managers of teleworkers will bring to this employment structure. We feel that expectations are critical, because as Forester (1988, p. 232) points out: "[M]ost of the existing literature on homeworking . . . seriously underestimates the psychological problems of working at home."

More important than how the literature assesses the situation is how individual teleworkers and their managers assess the situation. We feel that shared, apriori *realistic* expectations are essential in an environment which is forcing a co-location of work and personal space, and that the management model should develop *collaboratively* within each organization.

The prerequisite for this collaborative management model is that both managers and potential teleworkers have considered some of the salient issues associated with location-independent work. Our specific emphasis is to help teleworkers and managers of teleworkers develop a realistic notion about the demands made on both managers and workers to capably segregate work *time* and personal *time* when work and personal *space* overlap. By assessing the management policy jointly, both sides in the negotiation process will be better served and the resultant work relationship should be more satisfactory and stable.

5. CREATING SHARED EXPECTATIONS FOR TELEWORK

We approached the goal of creating shared, realistic expectations for telework by developing a *telework suitability scale (TSS)*. This instrument tries to help potential teleworkers and telework managers negotiate time spent away from a central office location. We constructed the scale by first surveying the literature in the area of telework and in the area of work and personal space. From this literature, we extracted a set of dimensions that we felt would suggest where an individual/organization pairing should establish an individual's work location: at home, at a satellite work center, or at a core office. The scale is constituted to suggest that many work relationships will end up as mixes in which part of the work is conducted at home, part at a satellite center and part at a central office. The amount of time an individual spends traveling is another important dimension in allocating an individual's work week.

In addition to the literature review, we followed Calabrese's (1988) advice and conducted case studies that involved in-depth interviews with co-workers and family members of teleworkers in addition to the teleworkers and their managers. These cohort relationships are important determinants of the teleworker's personal and work environments and the perspectives of these individuals greatly affect whether telework management policies are likely to succeed. We extracted comments from the transcripts of these interviews that we felt were important for potential teleworkers and their managers to consider. Users of the scale are asked to determine whether they would expect similar attitudes, perceptions and outcomes to occur in their own situation.

The first "ecosystem" from which we drew our interview data involved a female researcher, married, and with a young child at home. She works for a major telecommunications corporation that employs approximately 300 workers at the central office and has been an employee of that organization for two years. Our second case study involved an executive of a television network. He is married, with a teenage daughter at home and has a long history with the corporation, although his current position is relatively new. His work responsibilities require a great deal of travel, both domestically and internationally.

5.1 PERSONAL AND WORK SPACE

For purposes of our study, we have divided an individual's time between work and nonwork ("personal") activities and have assumed that both sets of activities can be (and in fact are) conducted in identical environments. For example, people have always taken work home at night as well as shopped and made personal phone calls during work hours. On a daily basis, and independent of where these activities are conducted, employees and supervisors must find ways to manage both work and nonwork activities.

Although careful not to be perceived as intruding, management obviously has great influence and interest in their employees' personal lives. Becker (1981, p. 186) points out: "Organizations typically consider family problems outside of their responsibility or concern, although they are fully cognizant of their negative impact on performance." Concern for the negative impact of an employee's personal circumstances on performance has led corporations to establish (among other interventions) substance abuse programs, childcare facilities, and financial consulting programs. This dilemma of "managing" an employee's personal life surfaces in teleworking arrangements because, as with substance abuse, childcare, and financial consulting policies, the goal of a telework policy is to coordinate work and nonwork activities as they relate to productivity, retention and employee satisfaction.

Individuals explicitly acknowledge the importance, and difficulty, of integrating work and personal activity into their different spaces. For example, our television executive has constructed a home office that purposely lacks windows to insulate him from personal distractions. His family (as reported by his daughter) has learned rules of when the office work can be interrupted and that these "breaks" are to occur in the kitchen, an area reserved for the family. A colleague of this individual, also a teleworker, describes his routine for "going to work" when he will be working at home. It includes, without fail, a shave, a shower and dressing for the office. These habits are used to reinforce the context of work in the home environment.

In the case of our researcher, this separation is not as pronounced. Although her child has full-time, in-home supervision, the researcher is comforted to know that in the event of an emergency she would be available and that she can allocate her time so that she can spend lunch with her infant. Sensitive to the researcher's home as a personal environment, her manager indicates a reluctance to call her at home even during the work day except for essential communication. In describing her own rejection of teleworking, one of the researcher's colleagues consciously uses her moderate (30 minute) commute from home to work as a time in which to "exchange her home and corporate personalities." In spite of the compromises this telework example entails, all parties to the agreement are satisfied with the arrangement and have established workable expectations of the roles of teleworker and manager.

The English research firm, *Applied Futures* has been evaluating the "Home of the Future" and the kinds of products that might be appropriate to it. They separate home activities into leisure, work, and maintenance related, and assume the population can be divided into segments based on how they perceive the activities to be carried out in the home. Their category scheme describes individuals as *outer-*, *inner-* or *sustenance-* directed.

Inner-directed individuals consider work as a means of self-fulfillment and freedom more than status. Outer-directed individuals are more defined by what they do and their need for visibility is greater. Sustenance-driven persons value security, often elaborated in a home and family orientation, above all.

Each group may relate differently to the idea of teleworking. For example, the sustenance-driven individual may prefer not to accommodate telework since the home as a place for personal activities is sacrosanct. Outer-directed individuals perceive themselves in broader environmental contexts and may be more amenable to telework *if* their work contributions are recognizable. Inner-directed individuals, who value work efficiency may be the most amenable to flexible telework arrangements if the issue of overcontrol can be resolved. The importance of the distinction among personality types is that a teleworking policy would need different motivational and outcome measures for effectiively managing sustenance-, inner-, and outer-directed groups.

The individual profiles used by *Applied Futures* reported here were based on the population of England and centered on the home. Other cultures have suggested the satellite work center as an alternative to either the core or home workplace (Osawa, Miura and Kurose, 1989; Qvortrup, 1989).

In the Japanese context, the "satellite," or neighborhood work center, has evolved to reduce worker commutes to large traffic-locked cities in which housing prices exceed the means of the average corporate employee (Saya, Nakabayashi, Shimoda, Terashima and Kadota, 1989). The home is not appropriate for most work in Japan because it is too small to accommodate an office, too difficult for an employee to be noticed and his/her work contributions acknowledged, and too associated with nonwork activities. Writing about satellite offices in a different cultural context, Qvortrup (1989) cites maintaining community identity and bringing rural populations together as important functions of the telecottages established in the Nordic countries.

Highlighting the differences among types of teleworkers and types of work locations allows us to associate variables that might influence who might thrive in which work environment. In the following section of the paper, we organize these variables that influence choice of work environment into a *telework suitability scale*.

5.2 TELEWORK SUITABILITY SCALE (TSS)[1]

Deciding where to work requires that managers and teleworkers consider: (1) personal characteristics of the teleworker, (2) social characteristics of the work environment, (3) technical characteristics of the work environment, (4) characteristics of the organization, (5) physical characteristics of the work environment, and (6) characteristics of the work. Each set of characteristics then can be matched with work locations. Finally, time in each work location can be allocated.

The first part of the scale presents variables related to the six categories of characteristics described above. Respondents are first asked to determine whether the variable is relevant or irrelevant in influencing their preferred work location. For those items which are considered relevant, the respondent marks a triangular graph which locates the respondent in a core office, satellite office, or home work environment.

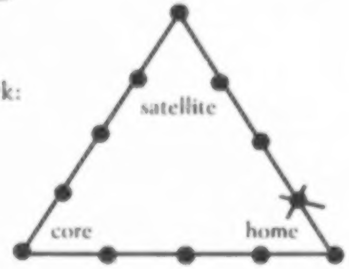
The second half of the scale presents common perceptions of the telework experience as reported by teleworkers, their managers, their co-workers, and their families. Respondents are asked to indicate on a semantic differential scale whether these concerns might apply in their individual circumstances (see Figure 1).

The teleworker and the manager independently fill out the *telework suitability scale*. Once each has completed the scale, each individually fills out the *work preference map* by apportioning days in a five day work week to one of three locations: home, satellite center or core office. The responses of the teleworker and his/her manager are then compared and serve as the starting point from which the agreement managing telework emerges (see Figure 2).

FIGURE 1. TELEWORK SUITABILITY SCALE

PART 1 Teleworker characteristic item
eg Commute time from home to work:

✓ relevant ___ irrelevant


satellite
core
home

PART 2 Perception item:

How do you think your *co – workers* would respond to this statement?

Teleworkers are pursuing personal agendas, not corporate priorities.

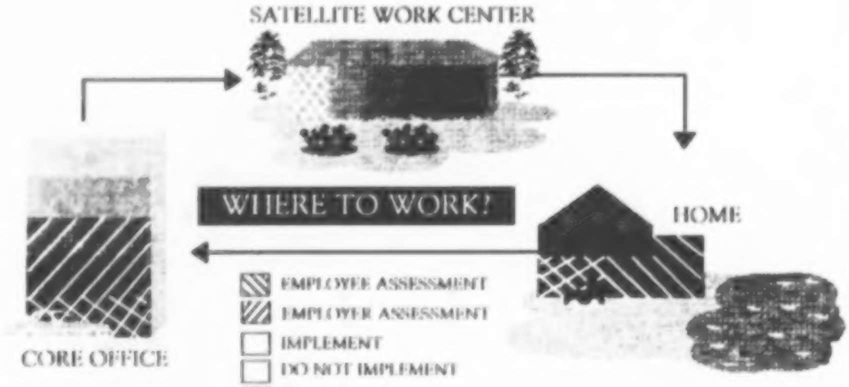
___ ___ ___ ✓ ___

strongly agree

strongly disagree

FIGURE 2. WORK REFERENCE MAP

Teleworkers and their managers individually fill out their *work preference map*. The degree of overlap between the maps is used to determine where to work.


SATELLITE WORK CENTER
WHERE TO WORK?
HOME
CORE OFFICE
▧ EMPLOYEE ASSESSMENT
▨ EMPLOYER ASSESSMENT
☐ IMPLEMENT
☐ DO NOT IMPLEMENT
☑ NEGOTIATE

5.3 SCALE ITEMS

The work and work environment characteristics covered in the *telework suitability scale* include:

Personal characteristics of the teleworker

"vice resistance"- ability to deal with a tendency to overindulge (e.g. cigarettes,alcohol, food)
tendency toward workaholicism
tendency toward procrastination
responsibility for nondirect supervision of homebound child/adult
membership in other organizations, clubs, professional affiliations
enjoy/require group work
biological clock affects work productivity

- tolerance for commute time and distance
- perceived importance of office politics

Social characteristics of the work environment

- spouse or significant other at home
- children at home
- neighbors receptive to work at home
- tax authorities satisfied with home as office
- depreciation schedules adequate for equipment purchase/replacement
- zoning laws permit home office

Technical characteristics of the work environment

- manageability/cost of additional telecommunications lines
- availability and reliability of technological support systems:
  - business phone
  - facsimile
  - phone recorder
  - pager
  - home computer and software
  - surge-protected power

Characteristics of the organization

- size of the work group
- polices of promotion/retention
- benefit packages (e.g. daycare facilities, company cars)
- source of social or strictly work contacts
- well-implemented electronic mail network

Physical characteristics of the work environment

- need for private work space
- need for "presentable" workspace for clients
- quality lighting
- comfortable furnishings
- adequate security
- handicapped accessible

Work characteristics

- work proceeds in parallel components rather than integrated parts
- frequent milestones on projects undertaken
- project outcomes are tangible rather than intangible
- confidentiality of work material

The perceptions about telework we used are included below. Respondents are asked to consider whether similar perceptions can be expected from persons associated with their work environment.

Manager perceptions

- Flexible work arrangements keep good people on the payroll.
- Staying at home increases staff productivity.
- Long term projects are hard to assess.
- Upper management will be frustrated when it can't find a worker because she/he was at home.
- It's easier to exclude than include the home worker from meetings.
- I don't need tight control but tight reward cycles to acknowledge achievement.
- Satellite work centers shared with other firms cause confidentiality problems.
- If our employees are going to work together, I want them all at one place, building a team.
- We need shared office work space to increase the financial benefits of teleworking.
- Coming in at least once a week is absolutely essential.
- I think the whole business of control is the crucial thing, measuring output.
- Offering teleworking as a work option shows you are loyal to your workforce, and they in turn will be loyal to you.
- Equipment and communication costs are just too expensive.
- The ideal teleworker fundamentally is decisive and able to act alone.

Teleworker perceptions

- Management still thinks you are really only good if they see you working 10 hours a day.
- The boss looks at output and is a futurist.
- The company should pay for all home office technology.
- Fewer interruptions at home improve my productivity.
- I need a long enough commute time to shift from an office to a home personality.
- I do an astronomical amount of my work outside of normal hours.
- My standard workweek is 100 hours, and I can't seem to stop.
- You need a spouse that understands, even if they don't necessarily agree.
- My boss worries that he doesn't have any control over me.
- I don't know know how others view me; as a confusing influence? Some might think I spend my time on holiday.
- My boss's and my work styles are so different that being in the same office would actually increase miscommunication.
- I'm cheaper to keep away from the office than at it.
- Telework has made a change in the architecture of my home.
- You need great phone skills to substitute for face-to-face contact.
- My business callers sometimes *apologize* for calling me at home.
- The organization was reluctant to allow my home phone to appear on the business card. They thought it looked unprofessional.
- There is a lot of change going on in the organization. Teleworking would be easier if things were settled down.
- Working away from the office has reduced the number of jobs dropped-on me.
- Telework is more relaxing since you're not "on show."
- A six month old baby is as demanding of your time if you're home at a terminal as if you were in the office with the baby in a basket.
- I think going to work is easier than managing both work and personal worlds at home. When you're at work, you get appreciated for the time you spend, you're in the flow.
- a nervous response to this situation is to overproduce physical documents just to appear busy.

Co-worker perceptions

- The advantages I perceive about teleworking have to do with teleworker's personal lives, not their work lives.
- Teleworkers are likely to get stale. They should attend several weeks a year of re-training in residence at minimum.
- When you're home, people don't think you're so serious.

Sometimes output is hard to measure, because the output is *lack of problems*. So, I can't tell if the teleworker is pulling the weight.
Bonding between me and teleworkers is very hard over the phone. It's easy face-to-face.
I can tell the resentment of my co-workers by their body language when we're in a face-to-face meeting.
Co-workers must see how the teleworker's work benefits the company. Occasional presentations are very important.
If they never let me down, I say go for it.

Family perceptions

I reach dad by ringing three special numbers on the phone so it will ring in his office. When he picks it up, I get him to come out.
My spouse is reluctantly supportive; our life is so complex we need the flexibility.
Teleworking has stolen my spouse's life.
My spouse is in better control and therefore more relaxed.
If my spouse weren't a time management pro, we'd all go crazy.
We lost a room of our house and that caused some problems.
I'm proud my spouse is trusted enough to be permitted to work from home.
I don't like the rule that a closed door means I can't come in.
There's no off-button. We have to find an off button for work.
With my spouse at home, when the child's asleep I can get out of the house. It's a terrific break.

5.4 LIMITATIONS OF THE TSS

The first limitation of the *TSS* is that it is not a formula to predict where someone will work. (To understand where an individual will work assess the labor market for the service provided by the individual in question. If labor is perfectly substitutable or if demand is nearly inelastic, the respective preference of management or the worker will prevail.) Rather, the *TSS* is a heuristic to foster discussion and to foreground some possible consequences of new working arrangements.

The second major limitation of the *TSS* is that the profile of an individual who travels frequently is not well represented. For the frequent traveler, we accept the conventional wisdom that most teleworkers should plan at least one day a week at the central office (Ramsower, 1985; Cross and Raizman, 1986). Travel days are subtracted from the remaining four work days. Those days which remain can then be partitioned among the three base work locations.

Finally, some would question whether a five day work week is not an outmoded concept, especially as the basis for a paper suggesting new arrangements for the conduct of work. We suggest that the scale be used to apportion work time on a percentage basis (with each day representing twenty percent of work time). Then, whether Hinely's famous "work cube" (40 hours x 40 weeks x 40 years) underestimates today's typical worker commitment to work or overestimates the typical work career of the future, the heuristic properties of the scale are maintained.

6. SUMMARY AND CONCLUSIONS

This paper considered the question of where an employee should work: at home, in a satellite work center, or at the core office. To address the question of where to work, a scale of suitability for telework was devised.

Whether teleworking is favorably received depends on the social community assessing the situation. This community is made up of the organization, the teleworker, and the associated families and co-workers. Each party may have a different sense of what is the proper work environment and will be more or less successful in visualizing changes from the status quo.

The importance of different characteristics of the work environment depends on individual circumstances and complex interactions within the social community and cannot be identified apriori. Based on this premise, the telework suitability scale is designed to uncover expectations through which employers and employees can pre-visualize and talk about the ramifications of co-locating work and personal activities.

Overall, the future of work will demand co-location of work and personal activities. Productivity and employee satisfaction require that all involved parties learn to be comfortable in merged work and personal space. The success of these new work arrangements will rely on establishing common expectations about telework in the minds of teleworkers and their managers.

[1] The *telework suitability scale* is available from either of the authors of this paper on request.

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The Report on Teleworking

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Kawasaki, Japan

1. ABSTRACT

Out of our commitment to telecommunications software development as a teleworking model over the last few years, we have installed teleworking offices in six cities in Japan so far. Various approaches are being undertaken in three offices to explore ways to build an optimal worker environment. This paper reports these approaches and the results of their implementation, and also introduces the concepts of teleworking metrics to guide the future deployment of teleworking.

2. CONCEPTS OF TELEWORKING

The continuing convergence of population in the metropolitan city of Tokyo has led to a host of annoying problems, such as rising land prices, traffic congestion, and air pollution.

Programs are being developed to ease these social problems by encouraging local industry, attaching more importance to human dignity, and so on.

Specifically, the Japanese government, municipal government and businesses are planning teleports, teleparks, EXPOs, and other events throughout the country of Japan in an effort to enhance the magnitude of rural activity.

In the present context of escalating business booms and convergence of population in Tokyo, concern over the shortages of manpower in rural areas takes on an increasingly serious tone, making leading local enterprises, municipal governments, etc. eager to call back manpower from Tokyo. Municipal governments have opened special channels of communication and organizations, such as reflux advisors and reflux information centers, to encourage the reflux of manpower. These programs put varied projects and new technological concepts into practice, promising solution to the prevailing problems and improvement on the worker environment in their own ways.

We, too, have installed teleworking offices in six cities throughout Japan to practice various approaches aimed at improving the worker environment, which ranged from employment of software engineers, enhancement of software productivity, constructing of intelligent office environments to the creation of properly distributed programming environments.

The results of the implementation of these approaches are now looming into prominence steadily.

Our promotion of teleworking has been primarily motivated by these goals: (1) giving solution to various problems connected with the convergence of population in Tokyo; (2) filling shortages in the supply of software engineers caused by the evolving services industries; (3) adapting to the on going eras of varied senses of judgement; (4) making effective use of information processing and telecommunications equipment, such as OA equipment and networks; and (5) constructing a high-productivity environment to meet expanding software demands.

In the light of these goals, we have defined teleworking as a scheme of work that permits one to concentrate on one's work during one's suitable hours in a place easy to live and work in, remote from the center, with the same quality of work as would be rendered in the center. The ultimate goal of this idea is getting most out of the individuals' ability by paying greater respect to humanity and allowing a maximum latitude of freedom and demand on the individuals' part.

Various activities are being staged in our teleworking offices to probe into how work should be broken down and how it should be carried out. The activities and features of the teleworking offices are introduced below.

3. PRESENT ACTIVITIES

3.1 STATUS OF ACTIVITIES

Since opening the first satellite offices in Yokohama in 1979, we have subsequently installed satellite offices in Osaka, Nagoya, Fukuoka, and Sendai, and more recently in Sapporo, the central city of Hokkaido .

In the overseas scene, we have software development work going on in our offices in Raleigh in the U.S., Hong Kong, Fuchou in China, and elsewhere.

Here are glimpses of the activities at the Sendai and Fukuoka offices to typical office environments:

- Sendai office

The Sendai office is devoted mainly to the development of software to work with overseas electronic exchanges. It employs engineers mainly from Sendai and from the surrounding Tohoku areas.

- Fukuoka office

The Fukuoka office works primarily on the development of software for overseas PBXs and hardware for electronic exchanges. Its engineers come mainly from the Kyushu district.

3.2 WORKING ENVIRONMENTS

(1) Common features

Each of our satellite offices is located in the readily accessible center of a local city in close contact with the cultural lives of the citizens.

The office environment is laid out and equipped with OA facilities to allow for ergonomic effects and show as a status symbol of that community.

The telecommunications network encompasses high-speed digital communication. electronic mail, and teleconferencing systems to narrow the spatial and time gaps.

The host computer is installed in the center (Kawasaki near Tokyo). The host is connected to the individual teleworking offices by high-speed digital communication lines to give them access to software file creation and utilization, database access, and so on.

The widespread application of Software Engineering Norm for telecommunication software development (SEN) is encouraged to expedite distributed programming work flows, thereby making for software of consistent, high quality.

The implementation of Software Management System for telecommunication software development (SMS) is contemplated to ease day-to-day development planning management and expediting tasks. Provisions are made for permitting development result data to be managed at both the individual offices and center.

A system, called AUMI, is used for quality management. The system permits feeding quality management data evolving from the successive phase of software development flow to the local offices into the quality management department of the center, so that the center can analyze the data and come up with visual measures of the product quality.

3.3 OFFICE-DEPENDENT APPROACHES

The office-dependent need for remote debugging facilities, target machine facilities for software development and testing, and local hosts is determined mainly with economic factors and software functional requirements in mind.

3.4 EXCHANGE OF ENGINEERS

The exchange of engineers between the center and teleworking offices depends on the offices and projects of interest. At present, this exchange is mainly effected by the local engineers visiting the development center on the following occasions:

-Software system testing (for predetermined time periods)
-Periodic meeting (one day)
-Group training (for predetermined time periods)
-Software development by recruits at the center for the first two to three years of their employment to consolidate their technical skills and promote future communication.
-Exchange of information between office managers

3.5 BENEFITS DERIVED UP TO NOW

-Principal benefits derived from teleworking so fare are listed below.
-Favorable effect on employment.
-Concentration on one's work in an excellent working environment, with a consequent shift in emphasis to output and performance.
-Good communication between engineers in each office.
-Effective utilization of local software houses.

3.6 EXISTING PROBLEMS

-Limited access to information, or noise, at the center due to only a few routes of information flow available.
-High costs of communication line utilization.
-Frequent need for managers to visit the center.
-Anxiety cherished by many engineers about their skill development.
-Few chances of attending academic meetings, exhibitions, conventions, etc.
-Unable to report to work from one's own homes.

3.7 PROBLEM-SOLVING APPROACHES

Shared use of design information

Shared use of software design information and know-how need be encouraged to help enhance engineers' skills, software productivity, and software quality.

Expansion in the channels of communication

Means of smooth communication need be enhanced to efficiently interconnect remote teleworking offices and accomplish established goals at all leaves of organization, from individuals to the management.

Deployment of satellite offices, such as Amobea

The workers' communication problems and housing problems now pronounced in the metropolitan area of Tokyo are now being duplicated in rural districts. To solve these problems, it would be necessary to build smaller-scale satellite offices in rural areas around the satellite offices in the local cities.

Creation and utilization of teleworking metrics

The planning and building of the facilities and working environments of satellite offices had traditionally been approached on a teleworking office basis, but the lack of the standard of assessment made it difficult to give directions in the improvement and expansion of satellite offices. Hence, teleworking metrics need be created to facilitate the creation of new teleworking offices, as well as to provide a standard of assessment.

Installation of intelligent offices
The frequent transfer of software files, design documents and the like between the center and teleworking offices would demand expensive communication line bills. To save these bills, the terminals installed at each teleworking office are refurbished to provide more sophisticated functionality and performance to facilitate efficient interaction with the host computer at the center.

4. INTRODUCTION TO REPRESENTATIVE MEASURES

4.1 PURSUIT OF EXCELLENT WORK WAYS

To create and put into practice excellent work ways tailored to new cultures, such as easy-to-work office environments, enhanced individual lives, and localization.

(1) CONCEPTS

Flex-working

Enables workers to exchange information to engineers, freeing it from its previous dependence on paper-based documentation and facilitating database implementation for easy management.

Smooth communication

Allows free interfacing between engineers and between the programming staff and the management by way of electronic documents and messages, beyond constraints of time and space.

(2) MEASURE SUMMARIES

[Information processing equipment]

Realization of human (engineer) oriented amenity offices
  Office climate conditioned for worker concentration (suitable sound, lighting, temperature, humidity)
  Provision of private spaces (small rooms, personal booths, partitions)
  Sense of spatial expansion
  Elimination of work waiting times (OA equipment, review rooms)
Creation of comfortable offices prompting the creation of ideas
  Installation of concentration rooms free from external disturbance
  Installation of idea creation rooms (in which anybody can freely exchange information with others)
  Refreshing areas (tearooms), foliage plants
Availability of one optimized workstation to each worker to get maximum of the worker's ability
Enhancement of computing power
  Quick responses in a distributed programming environment
  Reinforced DASD capacity to meet increased trends towards electronic documentation

[Key services]

Large-scale intelligent file access services

The following services will be implemented to enable the center and the local offices to share varied software assets (design information and know-how) and make their efficient use, without being ware of the space and time constraints (Figure 1):
  Remote and on-demand access to design information stored in a database under common management.
  Concurrent referencing of multiple entries of design information from one workstation available to each worker, without waiting times.
  Support of the fully integrated process of software development.

Smooth communication services

The center and the local offices are efficiently interconnected to make for smooth communication to accomplish established goals at all levels of organization, from individuals to the management (Figure 2).
  Multimedia communication services
  Automatic collection, accumulation, and delivery of development data

[Management]

Installation and utilization of software development operations
Comprehensive control is exercised over the technological and environmental aspects to concentrate the self-support development power of the local and overseas offices as the power of the organization as a whole and thus support efficient software development. This might involve centralized control of the successive process of software development at the individual offices, including the status of their development, progress, and resources, and the promotion of the distribution of technological concepts and architectures. (Figure 3)

4.2 SETTING AND UTILIZATION OF TELEWORKING METRICS

We are now working on the creation of teleworking metrics to analyze and assess the present scheme of teleworking and explore new ways of building future teleworking offices. This program is briefly described below with regard to its configuration and deployment.

(1) OUTLINE

Standard models of the standard teleworking user designer elements are established to reflect different implementations of teleworking, such as satellite offices, resort offices, and house-telecommuting. Various easy-to-use items and methods of assessment, such as equipment environment, management, and humanity, are defined to build an optimal teleworking environment.
These models may also be used in the analysis and assessment of the activity status and the equipment environment of the teleworking offices already in service.

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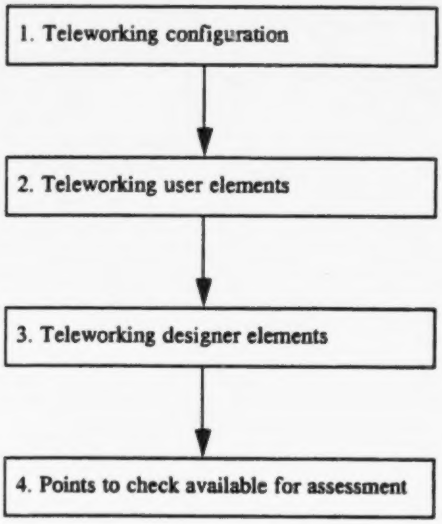
(2) DEPLOYMENT OF TELEWORKING METRICS

Teleworking user and designer elements are extracted and sorted to identify the points to check available for analysis and assessment.


1. Teleworking configuration
2. Teleworking user elements
3. Teleworking designer elements
4. Points to check available for assessment

(3) ITEMS OF METRICS

[User elements]

Production efficiency (Productivity)
Product quality (Quality)
Equipment utilization (Availability)
Equipment maintenance (Maintainability)
Equipment reliability (Reliability)
Database (Resource requirements)
Communication load (Ease of distribution)
Communication cost (Cost)
Space (Expansibility)
Ergonomics (Humanity)
Education and training (Ease of training)
Management (Manageability)
Activation (Activation policy)
Regional exchange (Regionalism)
Communication (Ease of transmission)
Independence (Spontaneity)

[Designer elements]

Building cost (Economy)
Equipment ownership (Ownership)
Equipment maintenance (Maintainability)
Database (Resource requirements)
Network (Ease of transmission)
Space (Expansibility)
Response time (Responsiveness)
Commutation and housing
HMI (Operability)
Ergonomics (Humanity)
Regional environment (Regionalism)
Management (Manageability)
Education (Ease of transmission)
Employment

[Items of testing and assessment]

Examples of typical items of testing and assessment are listed below.

Communication load

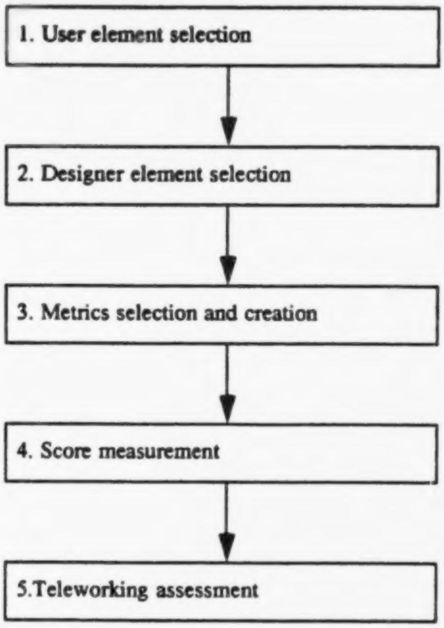
Information load, transmission speed, media type, line type, telecommunications terminals, communication protocols, usage frequency, communication control units, etc.

Ergonomics

Heights (desks, chairs, ceiling, terminals, etc.), colors (walls, desks, chairs, etc.), noise, floor elevation, air conditioning, refresh rooms, smoking rooms, etc.

(4) METRICS USE PROCEDURES

Metrics can be used in the following procedural flow:


1. User element selection
2. Designer element selection
3. Metrics selection and creation
4. Score measurement
5.Teleworking assessment

5. CONCLUSIONS

The preceding pages have introduced our approaches to the implementation of teleworking
We believe that these conceptual approaches to distributed software development would have application in all fields of industry, as including the development of communications software we are working on. At present, further expansion on the communication channels and common use of assets are sought on a global scale. It is our intention to promote global networking to encompass overseas as well as domestic teleworking offices. Yet, a number of problems need be solved before this goal can be accomplished. An example is how to create an optimal atmosphere at the center and local offices or how to convey the offices from background noise and other extraneous factors.

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[4] K.Nakamura, "VISUAL REPRESENTATION METHODOLOGY FOR THE EVALUATION OF SOFTWARE QUALITY"
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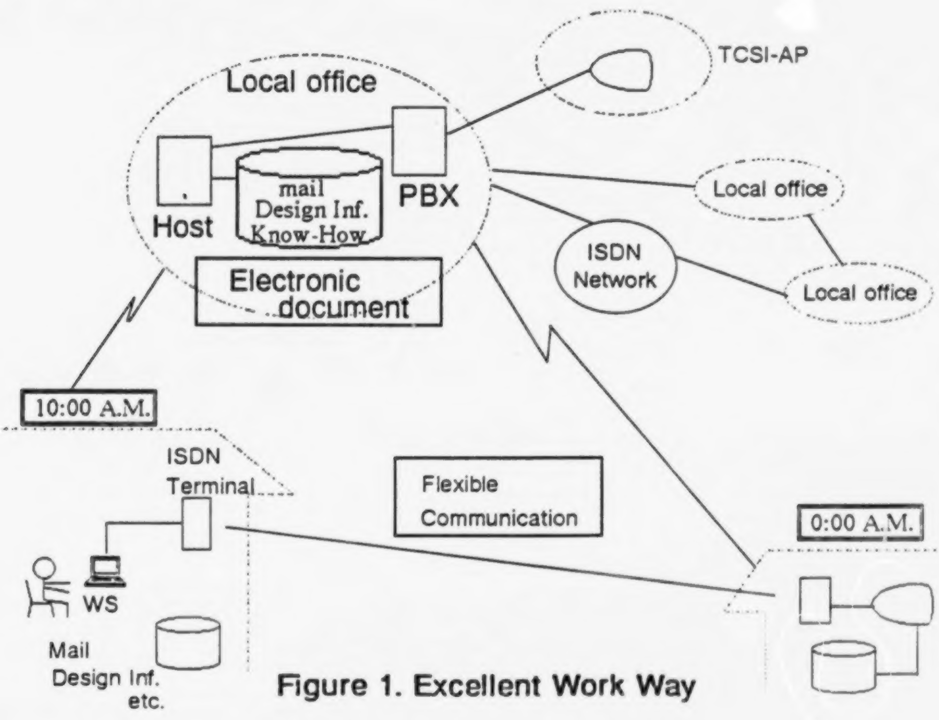
TCSI-AP
Local office
Host
mail
Design Inf.
Know-How
PBX
Electronic document
Local office
ISDN Network
Local office
10:00 A.M.
ISDN Terminal
Flexible Communication
0:00 A.M.
WS
Mail
Design Inf.
etc.

Figure 1. Excellent Work Way

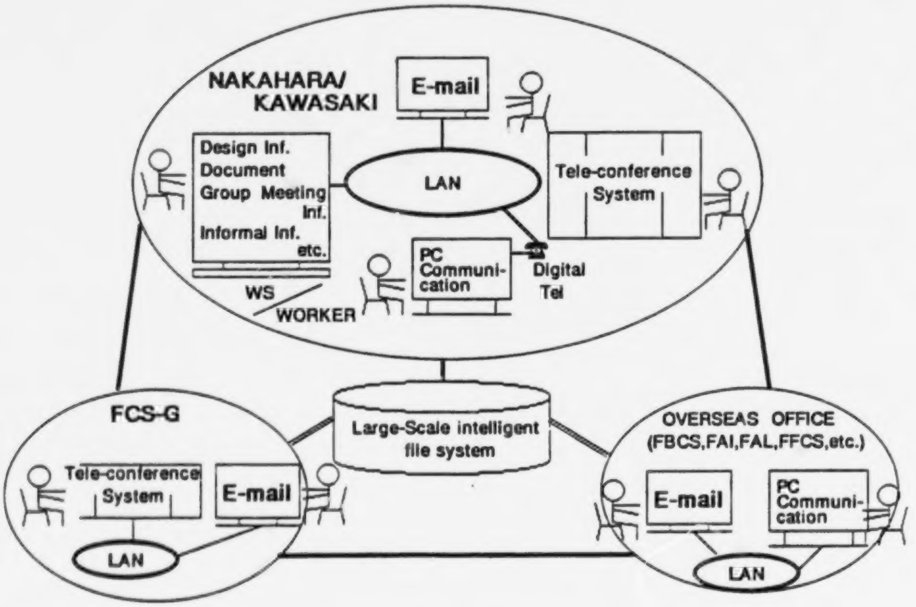
NAKAHARA/
KAWASAKI
E-mail
Design Inf.
Document
Group Meeting Inf.
Informal Inf. etc.
LAN
Tele-conference System
PC Communication
Digital Tel
WS
WORKER
FCS-G
Large-Scale intelligent file system
OVERSEAS OFFICE
(FBCS,FAI,FAL,FFCS,etc.)
Tele-conference System
E-mail
LAN
E-mail
PC Communication
LAN

Figure 2. Expansion on the Communication Channels

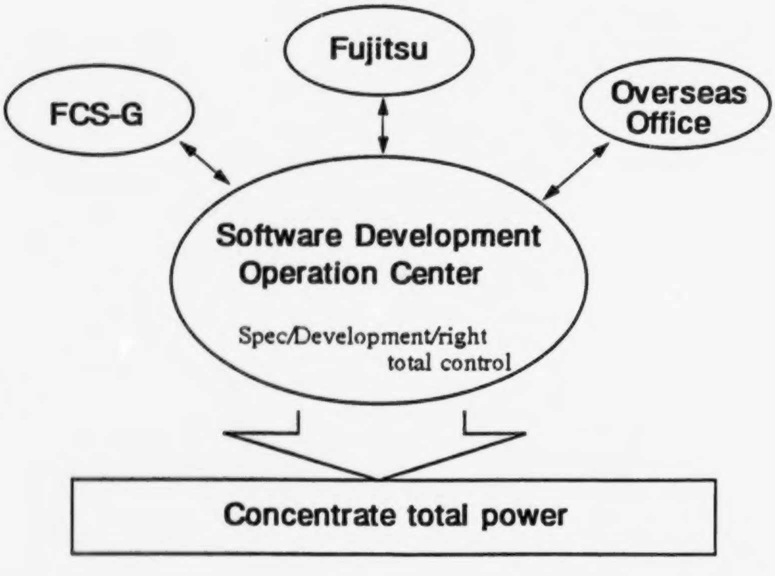
Fujitsu
FCS-G
Overseas Office
Software Development Operation Center
Spec/Development/right total control
Concentrate total power

Figure 3. Software Development Operation Center

Telecommunications for Urban-Rural Balanced Growth

John S. Niles, Center for the New West
Don A. Dillman, Washington State University

ABSTRACT

Two projects in Washington State, U.S.A. demonstrate how using telecommunications to move information instead of people supports an emerging public policy of balancing growth between rural and urban areas. One project is developing an information-intensive, rural-based enterprise for export marketing. The other project will demonstrate urban telecommuting. The two projects illustrate how remote work technology supports both urban growth management and rural economic development.

One important characteristic of the economy of the American West is that jobs and the people to fill jobs are geographically out of balance. In many locations, there are people who want work, but there are no jobs for them to have. At the same time, jobs go begging in other areas, because there are not enough people available locally to take those jobs.

Civic leaders in the western U.S.A. have the opportunity to paint new pictures of reality for the geographic organization of the economic landscape. Telematics, the mating of computers and telecommunications, changes things. Traditionally, desks in a single work unit have needed to be near to each other to facilitate physical movement of documents, and face-to-face communications between people. This proximity is no longer always necessary. As telecommunications bandwidth, data storage capacity, and computer processing power increase, document movement is increasingly replaced by electronic data streams. Face-to-face communications can be partially replaced by a variety of new electronic modes, including teleconferencing in all of its forms (1).

Advanced telecommunications -- that is, telematics -- can be a part of the solution to two related disparities between the location of jobs and people:

o First, across the western United States, there is an imbalance between the rural and urban areas. Jobs for information workers often go begging in the cities. At the same time many good people living in rural areas are unemployed or underemployed. This imbalance drives migration from rural regions to urbanized ones.

o Second, in the larger, more congested metropolitan areas of the west, such as Los Angeles, Seattle, and Phoenix, an imbalance is apparent in the location of jobs and housing. The spatial distribution of homes and work places results in congestion on the roads during peak commuting periods, and a resultant decline in quality of life.

The challenge of developing the economy in the western United States while simultaneously preserving quality of life lies in letting more people have desirable jobs, careers, and business opportunities at work locations close to where they live now, whether in an urban, suburban, or rural setting.

In general, the problem of jobs and people imbalance at both ends of the urban-to-rural continuum is being treated as two separate problems. Rural people work on rural development. Urban people work on telecommuting. The two groups don't often talk to each other, even though their interests could be viewed as two sides of the same coin.

RURAL DEVELOPMENT

In the U.S.A. western rural areas, agricultural, mining, forestry, and traditional manufacturing jobs are declining in number because of productivity improvements and enterprise shutdowns driven by market forces. But information-based branch offices and enterprises (telemarketing, insurance, finance) are an alternative source of employment (2).

One way new office jobs come to a rural area is through the arrival of a new facility set up by an established outside firm located elsewhere. Companies that cannot find a work force of sufficient quality and numbers in traditional urban settings can set up information-intensive branch operations anywhere that telecommunications can reach, which is almost everywhere. Setting up office operations in rural areas is an extension of a strong tendency for office operations to be increasingly located in suburban areas of metropolitan areas rather than central cities (3).

For example, a telemarketing firm headquartered in Omaha has recently created 43 new jobs in Breda, Iowa (population 500) as well as hundreds more telephone sales jobs in other Midwestern farm towns. A travel agency based in Philadelphia set up a telephone reservation center in Linton, North Dakota (population, 1,500), employing 40 local people.

Another path of rural job creation is the local incubation of new office-type enterprises, a tactic pursued by the Palouse Economic Development Council located in rural southeastern Washington State, and described next.

RURAL OFFICE ENTERPRISE

Whitman County, Washington (population 37,500; largest city, Pullman, population 22,000) has an economy based on agriculture (primarily wheat, peas, and lentils) and Washington State University. Lack of job opportunities and underemployment among the spouses of those employed or studying in the university community, and among the spouses and children of farmers is viewed as the leading economic problem. This underutilized work force is very well educated; there are many college graduates and even advanced degree holders available for employment. The local public schools have consolidated and provide a good K-12 education. In the minds of residents the quality of life is high, but economic opportunity could be improved.

In 1988, economic development officials in Whitman County initiated a task force of citizens to define a telecommunications-based revitalization project which would strengthen the local economy by creating new jobs. Some months into their effort, these leaders invited the Center for the New West, an economic development consulting organization, to facilitate several meetings of local business leaders to generate ideas for new businesses that could be originated by local entrepreneurs.

At one of these meetings in May, 1989, the attendees came up with the idea of establishing a telecommunications-intensive organization called the Global Agricultural Technology Sales and Service (GATSS) Center. This organization would package and market the resources of the many Whitman County agricultural-support businesses (providing equipment, seeds, fertilizers, and consulting, for example) to achieve a superior fit with the needs of overseas export markets.

Whitman County area businessmen already do some exporting to overseas markets. For example, one tractor dealer has sold equipment to customers in Australia and Jordan. The area is also home to several agriculture consultants who work internationally. A State of Washington computer bulletin board provides the local economic development agency with dozens of trade leads weekly from countries across the globe. But business owners in Whitman County, like those everywhere, do not have the time or the staff to exploit overseas market opportunities to anywhere near the full potential.

Thus arose the idea of the GATSS Center. Whitman County businesses could build export sales if they were all supported by a research-based, information-intensive staff office that could do market research, telemarketing, follow-up on leads, language translation, promotion and advertising, transportation and travel arrangements, document processing, deal packaging, and other services. GATSS Center would be the worldwide sales agency for the existing Whitman County agricultural support industry. GATSS Center would provide direction and energy for the future development of that industry.

GATSS Center's mission would be to provide customer-focused, total-problem solving to overseas agricultural development interests. Solutions would include delivery of a complete range of products and services packaged with expert information on how to use them. The knowledge base of the Washington State University campus and local businesses would be tapped. Planners envision the GATSS Center eventually doing large multi-product and service deals for developing nations. As of this writing, economic development officials in Whitman County are raising funds from the state government and foundations for the initiation of limited trial operations and further planning (4).

Two points of context are important to note with regard to the GATSS Center project: First, the idea of the GATSS Center is a grass-roots community counter-response to an initial project thrust by economic developers toward office development aimed at information services markets in Seattle and other urban locales. Instead, Whitman County business people expressed a preference for development of office industry in their community which supports local business needs, not the needs of Seattle.

Second, the GATSS Center would in fact be a traditionally urban business, one that would provide services typically found in an overseas trade center such as Seattle. The GATSS Center development is an attempt to build up a rural regional economy with indigenously-produced services, rather than assuming that such services are necessarily the province of large urban export centers.

URBAN TELECOMMUTING

Compared to the rural economy of the American West, the metropolitan areas are hot if not overheated. From San Diego to Seattle and inland to cities like Denver, Salt Lake, and Phoenix, urban areas are doing very well economically in relationship to rural areas, if not well in absolute terms. But the environmental impacts of economic growth -- congestion, pollution, crime -- are growing political issues in western cities.

Urban traffic congestion during rush hour results from the dispersal of the locations where people live and work. Telecommuting -- using telecommunication of information as a substitute for the daily commute from home to work -- means working at home for certain days of the week, or it can mean relocating jobs to alternative facilities closer to workers' housing.

In metropolitan Los Angeles and Sacramento California, and in the Seattle region of Washington State, government policy officials are setting up pilot projects which will show if telecommuting can be a significant technique for cutting back on the need for rush hour commuting travel between home and work. The October 17, 1989 California earthquake and its subsequent disruption of highway travel has also stimulated a higher level of ad hoc telecommuting in the San Francisco-Oakland-San Jose area of that state (5).

METROPOLITAN SEATTLE DEMONSTRATION

In a project initiated in mid-1988, the Washington State Energy Office is sponsoring a telecommuting demonstration in the Seattle-Tacoma-Bellevue-Everett metropolitan area. The project will include 10 to 15 organizations, mostly in the private sector. The objectives of the project are:

o to demonstrate telecommuting across a range of public and private organizations.

o to evaluate the impacts of telecommuting on individuals and organizations.

o to determine the impacts of telecommuting on traffic congestion, air quality, and energy use.

o to develop public policies for telecommuting.

Recruitment and selection of voluntarily participating organizations began at a Governor's Conference on Telecommuting held in Seattle in June, 1989 and continues through this writing. Orientation and training will be provided to each participating organization. Financial support for the project has been pledged by several foundations and telecommunications companies, in addition to state government support.

Participating firms are being asked to provide researchers with access to both telecommuters and a control group. The project will arrange for and support orientation and training of the telecommuters as well as their supervisors and managers.

Research data on the organizational and personal impacts of telecommuting will be collected through periodic questionnaires and interviews and by data from organizational records. Data will cover:

o worker behavior, especially absenteeism and turnover
o attitudes of workers
o work performance
o intergroup process and relations
o organizational culture
o organizational costs and benefits
o individual costs and benefits

Analysis of the traffic, air quality, and energy results of telecommuting will begin with surveys of worker's travel patterns at the start, middle, and end of the eighteen month data collection period. Over several days, participants will be asked to keep a diary of all trips, with recording of trip purpose, origin and destination, distance, starting and ending times, and number of vehicle occupants. (Home energy usage will be measured as well.) Analysis of travel behavior data will be used to shape alternative telecommuting scenarios, each quantitatively described. These scenarios will become inputs into a large-scale transportation impact model. Air quality and energy impacts of transportation behavior will be estimated from trip length data (6).

This project provides a way for governments and the general public to understand the public and private implications of telecommuting before it becomes widely practiced. This is especially important given that telecommuting is growing year-by-year in visibility, popularity, feasibility, and acceptance among both employees and employers (7). This project has already stimulated specific positive or negative reactions in the Seattle area from journalists, organized labor, public transportation planners, state legislators, telephone companies, and Boeing, the area's single largest employer.

The Washington State project is limited to telecommuting by employees of organizations having traditional office locations with which telecommuters are linked. That is, enterprises operating exclusively in residential homes are outside of the scope. Rural offices are also outside of the scope of the project.

COMMONALITIES

Both of these projects are being implemented to demonstrate how and toward what end economic geography can be reshaped, one project from a rural perspective, and the other from an urban perspective. Because of telematics, the feasible location of office work is widening. Office work is now feasible in small towns and in residential locations. In the two projects described above, public officials are trying to make what is technically feasible actually happen.

Both of these projects are being carried out independently of the other by different sets of people. This is understandable given the way knowledge, interest, and responsibility are fractured in the U.S.A. between rural and urban domains.

However, in the case of Washington State, this gap is closing. The contrast between the problems stemming from high growth in metropolitan Seattle and the problems of economic stagnation or decline in rural areas are being brought together by the analysts and shapers of public policy into a single statewide agenda (8).

The main conceptual linkage between the urban growth management agenda and the rural development agenda is this: Job and enterprise growth in rural areas contributes to stemming emigration to urban areas, and may even promote immigration from urban areas into rural. Theoretically, these forces make some contribution to slowing urban growth, while at the same time revitalizing rural areas.

At the moment there is no evidence that rural revitalization efforts like the Whitman County example described above even repeated hundredfold are going to reverse the dominant trend in the U.S.A. toward the concentration of economic activity and population in ever more sprawling urban agglomerations. As part of this process, rural areas on the periphery of metropolitan regions are assimilated and urbanized.

At the same time, while the prospects are good for telecommuting to provide new opportunities for firms and individuals to maintain or improve productivity despite growing urban congestion, we believe that telecommuting will tend to accelerate the market-driven, automobile-supported propensity for low-density residential and commercial sprawl. Early evidence indicates that living a long way from the office fits hand in glove with the telecommuting lifestyle (9). We are looking forward to the development of an outer ring of "teleburbs" around western U.S.A. cities. For the designed urban environment in aggregate, there will be less political motivation than ever to move toward the government planners' ideal of European-style high densities.

The interesting question is whether some of the still relatively healthy small towns of America located hundreds of miles from urban regions, will become fully integrated into the urban-dominant economic structure through technological "bridges," particularly telecommunications, but also including scheduled airline service and overnight package delivery.

PUBLIC POLICY

Clearly public policy can contribute to urban-rural integration. One policy thrust is to make investments which build up the attractiveness of rural areas as places to live and conduct business. In the case of Whitman County, strong state government support continuing for Washington State University in parallel with the pressures to build more urban campus facilities will help to keep the Whitman County area vital. Moving state government office work into rural regions via telematics would help as well.

On the other side are policies which limit the growth potential of the urban areas. Land use controls and decisions not to build infrastructure are examples of growth-limiting policies. On a piecemeal basis, these policies are the reality in metropolitan Seattle today. To land development interests and other economic boosters, growth-limiting policies are a problem. To many citizen activists trying to keep Seattle the nice place it is and was, these policies are an answer to a bigger problem.

Urban and rural political interests need to coalesce around the mutual goal of making both urban and rural projects like the two described above succeed. Successful urban telecommuting will lead to understanding and acceptance of remote work generally, and to the know-how and skill which lets urban businesses see rural office locations as part of the solution to urban labor shortages. Successful rural office industry will give urban businesses an additional resource to turn to for expansion as land use controls, development impact fees, environmental regulation, and rising prices make urban facility expansion more difficult and expensive.

Society's increasing ability to use telematics for moving information instead of people provides an unprecedented opportunity for achieving economic development in synchronization with popular preference. Knowing that telematics supports widely dispersed economic activity, government officials can confidently propose policies which aim to turn around rural-to-urban migration and growing urban congestion. Public policies aimed at restraining urban growth and encouraging rural growth can support a new vision of regionally-balanced and technologically-facilitated economic development.

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The Impact and Implications
Of Computer Mediated Interaction

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ABSTRACT

With the emergence of telecommunications technology has come the work group without walls, the computer mediated work group. Emerging research into the effects of computer mediated interaction has indicated there are some serious issues arising out of the use of this interaction. These issues are pointed out, and some suggestions are made about how to address them when implementing computer mediated interaction in organizations.

INTRODUCTION

The face of the work place is changing. Where, in the past, the offices and factories relied on the strength and reliability of their employees, the offices and factories of the present are becoming more and more reliant on technology. What was first office machines and automatic manufacturing equipment has now become word processing computers and high volume production robots. Workers of today are able to work faster, with greater efficiency, and in most cases in a safer work environment.

The work environment may soon also be undergoing a rapid series of changes. The emergence of new technologies, particularly in the computer and telecommunications fields, may radically shift the nature of organizations. These technologies have, led to decentralized or distributed organizations. The decentralization made it possible to expand organizations across state and country borders. Modern information technology supports the rapid production and transmission of information, facilitating strategic coordination and direction of assets. This can help organizations to remain competitive in the larger global markets. Indeed, without such use of technology, most organizations would not be able to compete in the marketplace today.

The introduction of telecommunication technology will have its effect on the work groups within those organizations. Along with the changing nature of the work is the changing structure of the work group itself. The era of face to face communication could soon be as far in the past as the horse and buggy. The same technology which allows the organization to spill across geographical boundaries makes possible an organization without walls. This can be accomplished through the use of computer mediated interaction. It is conceivable that in the future there will be many work groups, possibly entire organizations, which can work and produce products or services without a physical plant. Workers work interaction will be realized through the use of a central computer or the use of a computer network.

The ramifications of such workgroups are just now starting to be considered by researchers who study group phenomena. This paper will explore some of the emerging issues being raised about the use of such workgroups. This paper will also point out some of the implications of this trend in the work place, and what organizations must consider before implementing computer mediated interaction.

WORK AND THE TECHNOLOGY

The introduction of computing technology into the work place is hardly a new phenomenon. Since the early 1950's, there has been a massive influx of computing technology into the modern organization. From the relatively primitive data processors of the past we have progressed to the introduction of the integrated semiconductor chip. The technology has today advanced to the advent of smaller, more powerful computers which are quickly becoming as common on a managers desk as a telephone (Yen, et al, 1988). These computers can be networked together in such a manner as to allow the flow of the produced information to migrate to any physical location as is needed. This can be accomplished through a myriad of telecommunication network topologies, such as local or wide area networks, or distributed data processing systems. It is not the intent of this paper to explore the many telecommunications options and hardware configurations, but to point out that this technology does exist and has already found its way into many organizations.

Managers quickly discovered the benefits of producing and then disseminating information in the electronic digital form in which it was produced. Electronic information can very easily be transmitted as either a digital or an analog signal through existing, readily available telecommunications facilities, such as common carrier lines or microwaves signals. What this means for an organization is that there is no longer any need to operate with a tedious and inefficient traditional communication system. Production and transmission of information with today's technology can be nearly instantaneous. We need look no further than the local automatic bank teller machine to see a simple example of such a network.

Computing power can also be distributed to those users who need it most simply by providing them with the needed technology. Fortunately, the cost of the technology has been significantly declining since its introduction in the 1950's (Yen, et al, 1988). But, up until very recently, most of the research focus on the use of the technology has been on an individual user. In other words, the research has examined the technology producing and storing information for the individual users who need it. That information can then be used by those individuals for whatever reason, although mostly for decision making purposes. The problem with this scenario is that it largely dismisses the fact that in many cases decisions are made by groups of individuals working in concert, not sitting alone in different offices.

In many cases, decision makers may not even be in the same physical location, for any number of reasons (Turban, 1988). It can be too expensive, or simply not practical, to gather the decision makers into one location for the purposes of making some decision. What can be done is to take the networked computer terminals and to provide them with a facility that will allow them to communicate with other terminals. In doing so, we can facilitate nearly instantaneous production and communication of information between group members in geographically remote sites. From this came the concept of the computer work group. This work group uses a computer mediated interaction for their communication and work purposes, and may never see each other in a face to face exchange. All interaction takes place through the use of the computer terminals and communications software from remote sites.

From this foundation, the concept can be expanded to encompass an organization without walls, where employees can "telecommute" to work without the need to leave their homes. If an organization adopts such an approach, it would mean a smaller or no physical plant, allowing less overhead costs. While some feel that the telecommuting option is quite attractive and should gain a sizeable foothold in the work place (DeSanctis, 1983) others feel that the telecommuting is merely another employment option for employees, not the next wave of work (Olsen and Primps, 1984). While it would offer the workers the freedom to work at home, telecommuting would also mean that those workers could not as easily "leave the work at the office" at the end of the work period, nor would they see the other employees they work with.

This approach may become attractive as an alternative work option. The issue now raised is what impact this trend will have on the workgroups themselves? What is the effect of the interaction on the quality of their work relationships? What consequences can organizations expect when they form this type of workgroup? If this is a growing trend that organizations will have to consider, it is important to explore the aspects of computer mediated interaction before the workgroups are implemented, to be sure that they are effective for the organization and healthy for the workers.

ASPECTS OF THE INTERACTION

Social and applied psychology has been struggling for some time with the general concept of small group behavior. The researchers in these areas have been trying to formulate theories of how groups arrive at decisions, how individuals operate in groups, and why groups are sometimes ineffective as a means of getting work done. Almost all of the research that has come from these areas has been done on face to face group work. This means that the participants in the work groups interact with each other in the same physical location. As such, they exert influence on each other during the group interaction. While the body of research in this area has been growing, it must be questioned just how applicable this research is to the nature of the computer mediated workgroup. Since the computer workgroup may never actually SEE each other or share the same physical work space, can the theory be validly applied in this case?

Since the interaction is not fact to face, there is no direct exchange of contextual information, such as takes place in face to face interaction. Contextual information is the kind of information conveyed by facial expressions, physical surroundings, physical gestures, and the social cues that accompany them. There is a profound difference in the computerized interaction between group members, as they have NO direct facial contact. Since this is a different nature of interaction than that of traditional face to face communication, it is safe to assume that the dynamics of the interaction between the group members will likewise be different. In several studies, the differences between the two types of interaction has been, in some cases, quite profound; in other studies, the differences between the two styles of interaction have not been very significant.

The lack of the social context in the communication is the critical factor in the difference between the psychological aspects of computer mediated and direct interaction. Since this is a new, more technically based type of interaction, the social etiquette of the exchanges have not yet been established. Kiesler, Siegel and Mcguire (1984) point out that "no strong etiquette as yet applies to how electronic communication should be used." The communication is depersonalized, as the users may never see the immediate and direct effect that their messages have on the receivers. Because of this, the members of the group may feel free to engage in socially immature actions, such as sending of off-color stories and the playing of computer games during work periods. Such actions may lead to decreased effectiveness of the communication, and a loss of productivity.

Additionally, the lack of the context reduces or eliminates status and position cues which may be needed for effective communication. The users of such communication are "socially anonymous." This deepens the depersonalization of the messages sent, which already lack social context. Unless some other type of arrangement has been made, it is quite possible that
the users of the computer mediated interaction will have no knowledge of each other aside from what they experience as being a part of the interaction. All the users will be able to perceive of each other is what they experience from interacting with the CRT in front of them. This may create a sense of estrangement from the others in the interaction. Since the social contextual data is not present in the interaction, it is likely that the users may misinterpret what is being conveyed upon the screen. Or they may under or overinterpret what they see on the screen. The lack of mediating data, such as facial expressions, vocal tonal inflection, and physical position cues may lead to miscommunication.

There may be additional compounding effects from the use of technology itself. Those effects are largely stress related. There is a certain amount of physical and mental stress that accompanies the use of computer technology. The result of stress usually manifests itself in muscle aches and other minor physical symptoms (Dainoff, 1984; Johansson, 1984). This should not have a significant impact upon this type of communication unless the interaction is for prolonged periods of time. If the interaction requires long periods spent at the terminals, then there may be some more complex, antisocial manifestation of the stress finding its way into the communication (Brod, 1984). The users who work for prolonged periods of time with the technology may experience what has come to be referred to as "technostress", which causes the user to become aloof and socially withdrawn. Research into this and other stress manifestations has been, for the most part, based on the single user model of human-machine interaction. Such research is directly applicable to this type of group interaction, as both emphasize a similar use of the information technology.

When we examine the research done on computer mediated group interaction, some interesting results on the differences between using the technology and using face to face interaction become apparent. Kiesler, et al (1984) introduced the idea that this type of interaction would result in depersonalized, impersonal types of interactions. A later study by Kiesler, Zubrow, Moses and Geller (1985) bore out the same conclusion as measured by physiological arousal, subjective affect and expressive behavior in synchronous computer mediated interaction. In that study, when compared with face to face communication, computer mediated interaction elicited "asocial or unregulated behavior."

Later, in 1986, Kiesler and Sproull did another study, this time involving the use of an electronic mail (E-mail) system (Kiesler and Sproull, 1986). This study showed with the use of an electronic mail system for communication purposes the decreased social context cues changed the communication patterns in groups. For example, people would use the E-mail for "irresponsible" messages more than they would have in face to face communication, and that "undesirable" communication was more likely to be sent over the depersonalized, sterile electronic mail system. If the message was bad news, or just plain silly, the user was more likely to elect to use E-mail to send it.

The research on the impact of computer mediated interaction for use in decision making also has some interesting results. Until recently, the model of computer assisted decision making was that of the solitary decision maker interacting with the computer (Hedberg< 1970). There has, however, been some investigation done in the MIS literature about the use of group decision support systems (GDSS) to enable groups to more easily reach concerted decisions (Turban, 1988). A GDSS would be used by a group of decision makers interacting with each other through the mediation of a decision support system. This a narrowly specialized type of mediated interaction, as it is solely aimed at decision support. DeSanctis and Gallupe's paper on the development of such a system pointed out that the GDSS could contain built-in mechanisms to discourage "destructive conflict, miscommunication, or 'groupthink'" (1985), meaning that some of the more dysfunctional aspects of group decision making could be alleviated by the use of the GDSS. The group using the system could reach consensual decisions more quickly than they may in fact to fact interaction.

A study by Tjosvold and Field has shown that a certain amount of conflict in group decision making may actually be beneficial (Tjosvold and Field, 1984). Will the use of computer mediated interaction necessarily imply the removal of the element of conflict from the interaction? A recreation of Asche's social influence experiment (Smilowitz, Compton and Flint, 1988) has shown that during a computer mediated interaction, an individual will actually be more likely to dissent with others when making majority decisions and faced with what the individual feels to be the wrong choice.

In the recreation of Asche's experiment, users were asked to compare the lengths of certain lines on the CRT (Cathode Ray Tube). A solitary user was able to see, when choosing, what two other remote users were also choosing. Those two other users were deliberately choosing the wrong line in an effort to see how the experimental subject responded. In 95% of the cases, the experimental user picked the correct line despite what the other users chose, as opposed to the 52% choosing correctly in Asche's original experiment, which used face to face interaction. So perhaps the use of this type of interaction may actually be better for decision making, as it may allow individuals in the group to evaluate the information given without the "noise" of status or power positions. The information can be judged more on its factual basis rather than a political one.

If computer mediated interaction is implemented, the interpersonal nature of a work interaction can be changed very radically. A study performed by Adrianson and Hjelmquist (1988) on user experiences with a computer mediated communication system has shown that while the users perceived the system as being relatively friendly and easy to use, it can also foster a degree of misunderstandings and aggression in its use.

While the users liked the efficiency of the system, they preferred face to face interaction for more complex communication. Another study performed by Matheson and Zanna (1988) has demonstrated that the users of computer mediated communication had less public awareness of themselves, and that they were more likely to evaluate the social context of the communication negatively. These users were not sure what others felt about them, and what they did perceive was negative.

The importance of good interpersonal relationships between group members should not be downplayed in importance. For example, Kraut, Galegher and Egido found that among collaborating researchers, the most critical element in having a good research effort is the interpersonal relationship between the researchers (1987). If the interpersonal relationship between group members is so important to their functioning as a group, how will the use of this technology positively affect a group's social development? Will any type of good relationship between workers be fostered through the use of a depersonalized computer interaction? An interaction where it is more likely that the users will act immaturely and socially irresponsible? Where aggression and lack of unifying etiquette is present? The critical issue to be faced is how to deal with these questions when implementing this type of group. The research really does not address how best to do this.

IMPLICATIONS FOR THE FUTURE

Sproull, Kiesler and Zubrow, in Computing and Change on Campus (1987), stat that encountering computing can be like encountering an "alien culture" with different values and priorities. When faced with the prospect of the use of computer mediated interaction, or any other computer intensive activity, the users face a fundamental change in the nature of the work itself (Barker and Hoplin, 1989). The social cues that we have been socialized into suddenly do not apply. Many of the authors cited have pointed out there may be a shift in work patterns likely to occur as computer intensive jobs and computer mediated interaction becomes more common.

Jackson (1987) suggests that increased computer use may lead to an increasingly segmented organization. This will affect decision processes, and may result in more job dissatisfaction. Kling and Iacono (1984) state that with more computing there will be a greater opportunity for more social control, since whatever happens through the system can be monitored by the system. Tasks will be more sharply defined by the technology, and such may involve much less free expression on the part of the users. Tasks will be more limited, and much more closely monitored by the system itself: a computerized supervisor which never leaves workers alone for even one second in the work day.

Danziger (1987), Johnson (1984) and Mason (1986) have all stated that the increased use of the technology will not really bring on about a rash of new problems, but will exacerbate ole ones. Problems such as who will have access to the information passed in the interaction; how the transmission and the subsequent storage of information will be kept private; how the interaction can be kept secure; and how to insure that a possible alienation of the workers resulting from the use of the technology never happens. Many issues are raised, yet the answers are few. Most of these issues have not been addressed because until very recently they were not even imaginable. The technology changes so fast that organizations must scramble to keep competitive. Because of this, those organizations may not appreciate what possible future dysfunctional outcomes the technology may have on the workers.

Some have suggested that the use of the technology for interaction purposes will lead to new organizational forms (Crowston, Malone and Lin, 1987). Others see the technology as ultimately leading to the primary definition of the organizational form itself (Kling and Scacchi, 1982); the organization as a web of computing and information flows. How the introduction of widespread use of computer mediated interaction will affect organizational work groups is uncertain at this time, if indeed it does happen. More research into the effects of this type of work group is needed. Regardless of how the future is envisioned, a future with the possibility of this interaction demands changes, not just in research approaches to the use of the technology itself, but in the advancing of policies and procedures governing the use of that technology also.

The introduction of the technology into workgroups must be approached with less of the mechanistic, reductionistic approaches of the past (Carroll and Rosson, 1985). Most of the designs for these interaction systems in the past has focused solely upon the efficiency and productivity of those using it. This approach postulates that the man is merely another gadget in the system, just another interchangeable part. While that approach would be all well and good if the system were being designed to be used by machines, humans will not factor well into that system. An organic, user and functionally oriented approach would be better (Martin, 1981). If we neglect the human side of the interaction, we will in the long run allow the negative aspects of the interaction found by Kiesler, et al, to emerge. The approach must encompass the individual, group, organizational and societal aspects of the interaction (Wilpert and Quintanilla, 1986).

Restricting the interaction in the group solely to computer mediated interaction depersonalizes the communication to the point where the human element becomes lost. A past study has linked communication satisfaction to task satisfaction (Pincus, 1986), implying that the communication between group members is an element in their satisfaction with their work. If the goal of this type of interaction is to have a satisfied, healthy, and properly functioning work group, we must allow for some degree of face to face interaction. Without this more personal interaction, the workgroup may experience some or all of the negative aspects that have been previously mentioned due to the lack of effective, personal communication. In the long run, despite the speed and efficiency of the communication, the cost savings may be lost in lower productivity and less motivation.

There also should be more organizational focus on the policy level issues involved in this type of interaction. If this technology is implemented without the organization forming policies and procedures concerning its use, eventually management will be faced with problems that they never dreamed imaginable. One of the major shortcomings of the technology is that it because it changes so fast, it is almost impossible to foresee the long run effects of its use as it is being implemented. The technology must be used in order for the organization to remain competitive, so the more negative aspects are dismissed or downplayed as being trivial at the offset. Unfortunately, this haste leaves open policy level disasters for the future, issues dealing with access, privacy, and worker dissatisfaction.

Computer mediated interaction need not become one more in a growing list of computer system debacles. Policies need to be formulated with the users interests foremost in mind. The emphasis should not be so much on efficiency, as has been the approach in the past. The efficiency will be there if the system is implemented and used correctly; that is the nature of the beast. The policies emphasizing the users needs and concerns should circumvent more costly negative outcomes than loss of some possible system efficiency. The technology should be put in place to solve a problem or to address a need. Unfortunately, without the users foremost in mind, too often the technology becomes a bigger problem than what existed in the first place. The technology must serve the users, not subordinate them or their power of expression.

While the possibilities of computer mediated interaction are manifest and great, we must not neglect the interpersonal needs of the users who will use it by being overly quick to implement it without anticipating possible negative issues raised by the research. More research needs to be done in the social psychological aspects of the use of this type of interaction to see that it is best used to an organizations benefit. There are still more avenues that must be pursued in order to better understand and use this type of interaction.

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Telework: An Information Society Perspective

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1. ABSTRACT

Telework is a growing phenomenon fostered within the social structure of the new information technologies which facilitates capabilities for the production, manipulation, and processing of information. We argue that generic properties of telework converge on the social structure of the so-called information society. By making this argument, we examine the nature of telework based upon descriptions of the information society. The converging relationship between telework and the information society is also discussed.

2. EVOLUTION OF TELEWORK IN THE INFORMATION SOCIETY

Along with the progressive convergence of information-processing and communication technologies, information is emerging as a growing force in the world economy. A large workforce is connected to information or information-related industries, where the computer plays a central role in enhancing the movement and management of information among or within organizations.

New techniques of information production, handling and delivery have been developed with the aid of computer-based new information technologies. In the process of applying these technologies to their work, people have come to be able to be located anywhere there are communications links. The idea of "workplaces" is replaced by the concept of "work spaces" defined by computer-based networks. Perrolle (1987, p. 160) suggests, "'Where' people work will mean more than where they are physically located; it will mean what and whom they are connected to."

Thus, the new information technologies such as computer conferencing, electronic mail, electronic publishing, voice messaging, computer-based bulletin boards, and online databases can create a new relationship between individuals and their work. Such a relationship has engendered "the logical office," characterizing telework, where work no longer has to be associated with a single physical location but instead with logical locations.

Telework is defined as "an arrangement of work in which employees, individually or in groups, are geographically scattered via computer-based networks to reduce the need to travel to and from a central office." Several terms that describe some aspects of the nature of telework include telecommuting, work-at-home, and remote work, while telecommuting and telework are the most frequently used. The meanings of telework and telecommuting are apparently not the same.

While telework means *working remotely via computer-based networks*, telecommuting focuses on reducing the cost of transport (Renfro, 1986). Two aspects of telecommuting include the imported cost of fuels affecting the international trade balance and the congestion and environmental problems of transport influencing our lives. Telework may also be concerned with reducing the expense of office space and with staffing flexibility (Atkinson, 1985).

Characteristics of successful telework are: (a) use of computers and the new information technologies is provided; (b) location is independent; (c) constant supervision is unnecessary; (d) work deadlines are longer-term and flexible; and (e) goals are definable. (cf. Calabrese, 1989)

As with the growth of information-processing technologies, telework is a phenomenon taking place within the social structure of the information society, where workers operate computers and the new information technologies as well as produce, process, and move information in organizations (Porat, 1977). A key feature of telework in the information society is the usage of computer-based new information technologies. We argue that telework is a social phenomenon that is apparently fostered within the social structure of the information society.

Innovations and developments in information-handling using the new information technologies have contributed to the concept of the "information society," where individuals "perform information work in a wide variety of occupations and their main tasks include the production, recycling, or maintenance of information and/or information technology" (Schement & Lievrouw, 1984). The evolution of the information society can be characterized by the transformation of its economy and workforce, driven by a series of revolutions in information technologies.

In the information society, industries and occupations that produce and distribute information become central to the economy. The manufacture and distribution of the new information technologies form the technological and organizational base of the information society.

As the telephone becomes more and more integrated with computer technology, the requirement for workers to be physically located in the traditional work environment is getting less and less significant. Individuals can work in a logical office, where they are geographically scattered and communicate via computer-based networks within the organizational structure.

The irrelevance of distance and location contributes to the decentralization of society and fosters indirect relationships among people (Calhoun, 1987; Nilles, 1986). Individual teleworkers can be "independent entrepreneurs" who own their own computers and information technologies and produce, manipulate, and process information (Toffler, 1980). This new breed of independent entrepreneurs has been termed "infopreneurs," people who use the new information technologies to gather, organize, and disseminate information as a business venture or as a value-added service (Weitzen, 1988).

Telework is spreading. A recent report says that there are 15.8 million teleworkers -- corporate employees who work at home either part time or full time -- while in 1985 there were about 10,000 to 30,000 teleworkers -- "home-based office workers using electronic equipment" (Kelly, 1988; US Congress OTA, 1985).
Is the phenomenal growth of telework due to the innovations and developments of the new information technologies?

Telework is primarily performed as part of information-handling occupations using the new information technologies. It is a growing social phenomenon within the structure of the information society, that is, a set of networks of interdependent information-processing relationship between teleworkers and managers. The generic properties of telework are made up of such information-processing networks linked together via computer-based network regardless of distance and location.

3. COMPONENTS OF TELEWORK: TECHNOLOGY, HUMAN, AND TASK

Figure-1 diagrams the flow of information-processing in telework. As shown, each phase implies the flow of information-processing via telematics, defined as the convergence of information-processing and communications technologies. In Japan, similar concepts are known as "C&C," for "computers and communications" (Kobayashi, 1988) as well as "johoka shakai" for "informationalized society" (Ito, 1981). (Also see Beniger, 1988.)

The telematically-connected logical office consists of three components: technology, human, and task. Information, a product to be processed, is created when a worker uses the computer technology to manipulate and process the product and completes his or her tasks assigned by managers.

Technological components include such facilities as telephone, facsimile, electronic mail, desktop publishing, computer conferencing, online databases, and voice messaging. They extend the capabilities of individual and organizational networks and assure high-speed reliable transmission of information.

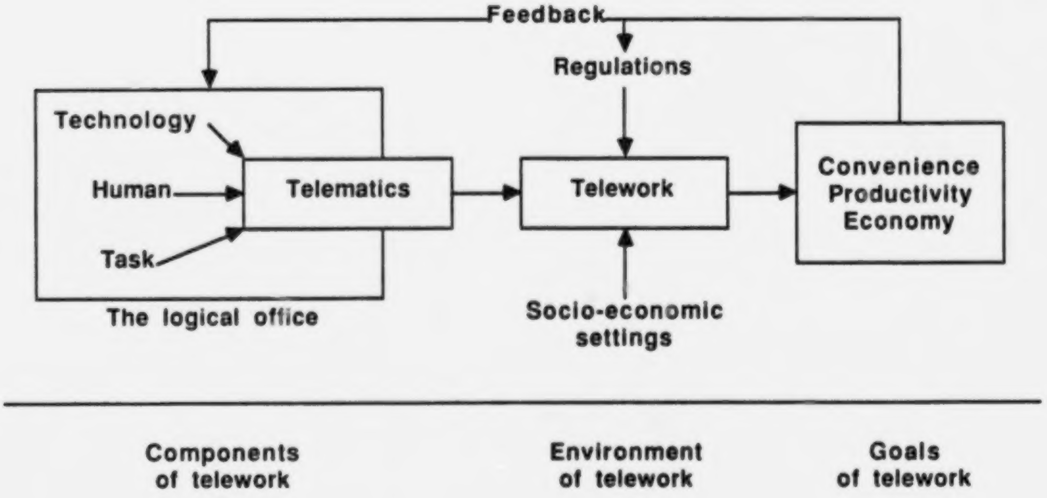
The logical office operates through telematics making the information handling (information production, information processing, and information manipulation) possible between teleworkers and managers.

Computers and high-speed telecommunications allow work to be distributed in different locations. Modern transportation and communication technologies have made social compactness unnecessary for conducting most of today's economic and social exchanges (Kasarda, 1980).

Telework particularly fosters the human attributes of autonomous planning, self-discipline, and inner-directedness (Nilles, 1984). Teleworkers should have achievement motivation, persistence and discipline, the ability to organize, prioritize and manage time, and self-direction and independence. High needs for socializing, structure, acceptance and recognition will not be met in telework, because teleworkers work at home under their own direction and at their own pace (Nilles, 1984; Peelle, 1982).

Other requirements include: experience in handling the work itself and the new information technologies; and confidence in

Figure-1: Information-Processing in Telework



achieving the required results with little guidance (Spence, 1989).

Task components appropriate for telework include routine tasks, creative work, and technical and research work. Telework is suitable for information-handling or knowledge-producing work such as journalism, computer programming, clerical tasks, creative work, technical work, research, and sales profession.

4. ADVANTAGES AND DISADVANTAGES OF TELEWORK

Hellweg, Freiberg and Smith (1984) attempted to find out the extent of usage by American organizations of new information technologies that can be adopted as major telework media technologies, such as electronic mail, interactive computers, videoconferencing, videotex, and word processing.

Their conclusions were: (1) word processing was the most pervasively used technology, used mostly by secretaries in virtually all major companies; (2) interactive computers were found in nearly every major corporation, used mostly by technical specialists and middle managers for information retrieval and storage and problem-solving; (3) electronic mail was used in about 1/2 of the companies, mostly by middle managers and technical specialists for information dissemination; (4) videotex was used in 1/4 of the companies, again mostly by middle managers and technical specialists; and (5) videoconferencing was rarely used in any of the companies.

The use of these new information technologies was found to have resulted in an increase in employee productivity, job satisfaction, corporate information capability of dissemination, storage and retrieval, employee time management capability, and workload capacity of company offices, but a substantial number of employees were slightly apprehensive about the possibility that the new information technologies might reduce interpersonal contact with others.

Social benefits of telework are: that communities can reduce traffic congestion by allowing employees to work close at home; that telework promotes the adoption of computers and the new information technologies; that telework allows savings in office space rentals and parking fees and dispersing economic activity to suburban areas; that telework also provides some handicapped people with increased employment opportunities; and that telework improves environmental conditions by decreasing traffic congestion and fuel consumption.

Economic advantages of telework include enhancing productivity, convenience, and economy. Productivity means worker output within a given period of time. Providing a worker with more sophisticated technologies will improve employee convenience as well as productivity in production and processing of information via computer-based network.

Other benefits of adopting telework include: (1) to improve the quality of work life; (2) to be more productive without interruptions by co-workers and supervisors; (3) to maintain autonomy and flexibility in work schedules; and (4) to live in remote locations and avoid the daily commute from suburban to urban locations. (cf. Albertson, 1977; Antonoff, 1985; Becker, 1986; Dordick, 1985; Hamilton, 1987; Kraemer, 1982; Olson & Tasley, 1984; Shamir & Salomon, 1985)

From the employer's point of view, the major benefit of telework is economic, such as facility and labor cost savings, energy and environmental gains, and improved job performance. However, the question of how the expensive cost of the new information technologies should be managed in adopting telework has yet to be answered.

Telework also operates within regulatory and socio-economic environments. Some potential policy concerns about telework are[1]:

(1) Piecework-basis payment, whether measured by pages typed, claims processed or computer strokes recorded.

(2) Lower payment for teleworkers than for the traditional workers, due largely to the fact that teleworkers are not paid for such necessary activities as setting up, correcting, printing, collating, etc. -- and certainly not for the time spent in social interaction -- which are paid for in an office setting.

(3) Absence of benefits, such as health insurance, vacation and sick leave, pensions, and Social Security contributions, which in toto can constitute as much as 30% of payroll.

(4) Lack of a guaranteed or stable flow of work and thus of a non-dependable flow of income.

Other major disadvantages include employee overwork, exploitation, and social isolation (Calabrese, 1989; Calhoun, 1987; Hamilton, 1987). This means that while telework increases the free flow of hard information such as textual and graphic data, it reduces the free flow of social information such as eye contact, tones of voice, and gestures.

Teleworkers tend to overwork by working extra hours and missing the sociability and status maintenance occurring in the central office. Social isolation can be alleviated by "high touch," or encouraging the building of stronger relationship between teleworkers and on-site employees (Naisbitt, 1982). Workers are concerned about the possibility that the new information technologies might reduce interpersonal contact with others.

Sociability and drive for status are two individual attributes that influence one's communication behavior in organizations, where sociability means "the degree to which one tends to communicate with others" and drive for status refers to "the degree to which one responds to status stimuli, the opportunity to gain, or be associated with, higher levels of social ranking" (Rice, 1987).

Work is self-actualizing when teleworkers are provided the opportunity to express their sense of self through activity that contributes to society and gives them a valued social status. Individuals' self-actualization, sociability, and drive for status in telework should be carefully considered before an organization adopts any telework system.

5. SUMMARY AND CONCLUSION

Telework is defined as "an arrangement of work in which employees, individually or in groups, are geographically scattered via computer-based networks to reduce the need to travel to and from a central office." This paper has examined the nature of telework from the perspective of the information society.

Telework is spreading as the new information technologies are becoming pervasive. It is also growing within the social structure of the information society, where individuals perform the information activities in a variety of occupations including the production, recycling, or maintenance of information and/or information technology.

Computers in an organization have created a new environment between individuals and their work, that is, "the logical office," where work no longer has to be associated with a single physical location but instead with logical locations. The logical office operates through telematics -- the combination of computing and telecommunication -- within three components: technology, human, and task.

The new information technologies are forces that influence information-handling work in organizations and make telework a social phenomenon in the information society. Various advantages and disadvantages of telework are also discussed. While improved productivity, convenience, and enonomy are major benefits of telework, overwork, exploitation, and social isolation are recognized as disadvantages to teleworkers.

Note

1. (1986) H. R. Rep. No. 99-677, 99th Cong., 2d Sess. at 3.

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Session 6.5

Electronic Trade

NOTES

KDD's E-Mail Service and Facsimile S&F Service Based on X.400 Systems

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ABSTRACT

The need of E-Mail service is gradually growing and nearly 3 million G3 facsimile terminals are in use in Japan. In order to handle these growing communication more efficiently on world-wide basis, KDD has introduced the S&F(store and forward) type service based on X.400 systems.

This paper describes those KDD service and systems based on X.400 Recommendations.

1. Introduction

As the public data network has expanded into the area of general use, the requirement to establish a global message communication network that can handle not only characters but also other media like facsimile has been increasing.

In the CCITT 1981-1984 study period, Study Group VII started under the question of MHS (Message Handling System) the study of multi--media S&F exchange system.

Considering such an environment and requirement for the global multi-media communication, KDD has developed X400 system since 1981 and has applied its technology to actual services.

2. X.400 (MHS) system developments in KDD

KDD started the development of a prototype MHS which accommodates X.28, G3 facsimile and TTX(Teletex) terminals in Dec. 1981 and completed it in Mar. 1985. KDD applied the technology to both public and private communication services.

Five independent systems were in use for global multi-media communication within a company, mostly big Japanese trading companies.

The first application to the public service is E-Mail service. In section 3, the details of E-Mail system and service are described. The second application is G3 facsimile S&F service, which is described in detail in section 4. In addition, KDD also developed the system to accommodate G4 facsimile terminals, which is described in section 5.

KDD is now developing the new generation MHS, outline of which is described in section 6.

3. E-mail service(MESSAVIA)

3.1. Outline

In order to meet user needs for wide variety of telecommunication services, KDD has introduced a character oriented electric mailbox service "MESSAVIA" on September 1,1986, which system is based on the '84 version of CCITT X.400 series Recommendations in order to facilitate interconnection with world-wide messaging systems.

The service was provided without X.400 interconnection for first two years. After confirming in Telecom'87 its interconnectivity with major X.400 systems such as AT&Tmail of AT&T, Telemail of Telenet, Gold400 of BT, Atlas400 of Transpac, Telebox of DBP, arCom400 of SwissPTT and NTT-PC Network of NTT. MESSAVIA started X.400 interconnection with some of those systems. Besides, at Telecom Japan '89, MESSAVIA was connected to major Japanese E-mail systems and its connectivity was confirmed.

3.2 MESSAVIA Services

3.2.1 Service Elements

The service elements which MESSAVIA provides are as follows;

- Multi-destination delivery
- Receipt Notification
- Non Receipt Notification

- Delivery Notification
- Non Delivery Notification
- Delivery to arbitrary G3 facsimile terminals
- Delivery to arbitrary telex terminals
- Message Tracing

3.2.2 Service Areas

As of Dec.1 '89, foreign E-Mail systems connected to MESSAVIA are AT&T(U.S.A.), Transpac (France) and DACOM(Republic of Korea). And BT(England) and Western Union(U.S.A) will be connected soon.

3.2.3 Charging Structure

Charging structure has the following component:

a) Contract fee
b) Basic fee(per month)
c) Access fee
d) Message transmission fee
  i) Exchange fee(per address)
  ii) International transmission fee
    (per 100 characters)
  iii) facsimile delivery fee
    (depends on charges of service connected)
e) Storage fee(per 1000 characters, per day)

3.3 Network Configuration

Network configuration is shown in Fig 1.

3.4 MESSAVIA functions

3.4.1 Basic functions

(1) Interpersonal Messaging with E-mail users: A MESSAVIA user can send a text mail to users of MESSAVIA and of other MHS systems connected. A user can specify any form of O/R name as an recipient's address. A MESSAVIA user can receive a text mail in his mailbox from users of MESSAVIA and of other MHS systems connected. A user can retrieve messages from his mailbox.

(2)Delivery to arbitrary G3 facsimile terminals: MESSAVIA is connected to KDD's facsimile S&F system (F-PORT, see section 4) and foreign messaging systems which can deliver a text mail to a G3 facsimile terminal with conversion. Making use of these connection, MESSAVIA users can send a text message to arbitrary G3 facsimile terminals by designating telephone number of it.

(3) Delivery to arbitrary Telex terminals: MESSAVIA is directly connected to Telex network via Telex Interworking Unit and is connected to foreign messaging systems which can send a text mail to a telex terminal. Making use of the connection, MESSAVIA users can send a text message to arbitrary telex terminals by designating destination telex number and optionally its answer back codes.

3.4.2 Additional functions

(1)Delivery Notification: When the user submits a message, he can request delivery notification, meaning of which depends on the definition of each MHS system. The definition of it in MESSAVIA is to notify whether the message was put in the recipient's mail box or in the queue for forced delivery.

(2)Receipt Notification: When the user submits a message, he can request receipt notification, of which meaning depends on the definition of each MHS system. The definition of it in MESSAVIA is to notify whether the message was read out from the recipient's mail box or was successfully received at the destination terminal.

(3)Message Tracing
The processing status of each message is recorded in the message tracing file and an user can get the report of his message to know whether the message was successfully delivered and so forth.

4. G3 facsimile S&F service(F-PORT)

4.1 Outline

Recently, international facsimile transmission has been increasing from/to Japan and most of facsimile communications are realized via the Public Switched Telephone Network (PSTN). These facsimile communications are done via analogue telephone circuits with 2,400-9,600bps modem equipment. However, since neither network nor facsimile terminal (Group 3 facsimile) has error correction function, there are certain

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difficulties such as image distortion and communication interruption.

In order to improve these difficulties in communication qualities and to introduce some additional services, KDD has developed the International Public Facsimile Store & Forward System based on CCITT X.400 series of recommendations (Message Handling Systems).

4.2. F-PORT Service

4.2.1 Service elements

The service elements which F-PORT service provides as follows;

- Delivery to arbitrary G3 facsimile terminals
- Delivery to subscribed G3 facsimile terminals
- Multi-destination delivery
- Receipt notification
- Non receipt notification
- Deferred Delivery
- Input message cross reference report
- Output message cross reference report
- Abbreviated address
- Group address

4.2.2 Service Areas

There are two ways of expanding the service areas.

a)Installation of FPADs(see section 4.3): The installation of FPAD is the first step to start this service. Many of the following areas are planning to have their own MHSs as the next step. As of Dec.1 '89, the service areas with FPADs are U.S.A(Jul.'87), Philippines(Jul.'88), France (Jun.'89), Thailand (Oct.'89), Taiwan (planned on Dec.'89) and Singapore (planned on Feb.'90).

b)Interconnection using X.400 interface: The service areas with X.400 interconnection are OTC/Australia (planned on Mar. '90) and AT&T/US (planned on Oct. '90).

4.2.3 Charging Structure

The charging structure is composed of the following elements;

a)The basic monthly charge

b)the transmission charge(on a per page basis and depends on A4/B4 and Fine/Normal)

4.3 Network Configuration

The network configuration of F-PORT service is shown in Figure 2.

The F-PORT system is composed of the following equipment facilities:

(1)MHS (Message Handling System): This equipment has store & forward and transfer function and other additional facilities. To transfer messages between MHSs, this system uses P1/P2 protocol defined in CCITT X.400 series of recommendations.

(2)FPAD (Facsimile PAD): This equipment converts the G3 facsimile protocol (CCITT Recommendation T.30 and T.4) into FPAD-MHS protocol, which is a locally defined layer 4 protocol on the packet layer (X.25) and vice versa, which makes it possible for G3 facsimile terminals to access the system via the packet switching network.

(3)PSE(Packet Switching Equipment): This equipment connects FPADs with MHS.

(4)IWU(Interworking Unit): This equipment is an interworking unit which connects FPAD with the international telephone switching system.

4.4 F-PORT Function

4.4.1 Basic functions

(1)Identification of an originator: In order to identify an originator, his telephone number which is transferred from the domestic telephone network, is used.

(2)Message address: After the connection is completed, he input message addresses using DTMF(Digital Tone Multi Frequency) in order to specify the destination, the following four types of addresses are used.

a)User address (6 digits): to specify the subscribed users.

b)Telephone number address (up to 15 digits including prefix "001"): to specify arbitrary G3 facsimile terminals.

c)Abbreviated address (2 digits): to specify a

single user or telephone number address.
d)Group address (2 digits): to specify up to 32 user and telephone number addresses.

(3)Message delivery: The system attempts to deliver each message according to the address specified by the originator. When the system could not deliver a message to a destination terminal due to line failure and so forth, it will try a fixed number of times to deliver the message with a certain interval.

(4)Non receipt notification: If a message could not be delivered after a certain time of attempts, the system will stop the attempts and will return to the originator Non receipt notification with the first page of the original message.
The example of message delivery sequence is described in Figure 3.

4.4.2 Additional functions

(1)Receipt Notification: When the user submits a message, he can request Receipt Notification on a per message basis. In the case where Receipt Notification is required, the system will return Receipt Notification to the originator when the message delivery was completed.

(2)Deferred Delivery: When the user submits a message, he can specify the delivery time of message. The system holds the message until the designated time and starts the message delivery when the designated time arrived.

(3) Input message cross reference report: Each input message is identified by originator's user address, input serial number and input time. The processing status of each message is recorded in the input message cross reference file and an originator can get a report on messages which he input to the system.

(4) Output message cross reference report: Each output message is identified by recipients' user address, output serial number and output time. The processing status of each message is recorded in the output message cross reference file and each recipient can get a report on messages which the system output to him.

(5)Abbreviated address modification: A user can modify his own abbreviated address by the DTMF command.

(6)Group address modification: A user can modify his own abbreviated address by the DTMF command.

4.4.3 Remote management

In addition to the normal network management functions, the system provides the function that operators of the organization where the FPADs are installed can supervise their own FPADs and subscribers. That is,the service area is subdivided into a region which corresponds to FPAD location; the FPADs' and subscribers' management data can remotely be updated within each region.
Remote management functions are divided into the following three functions:

- Remote management of network status
- Remote control of traffic
- Remote management of network data

(1)Remote management of network status: The system sends the alarm messages concerning the status of FPADs and circuits within the region to the terminal (called Regional Alarm Terminal) in each organization's premises, which is connected with the system via PSDN.

(2)Remote control of traffic: From the terminal (called Remote Traffic Control Terminal) which is connected with the system via PSDN, an operator of each organization can control the traffic (e.g. to stop the message flow to his FPAD) within his region by the operation commands.

(3)Remote management of network data: From the terminal(called Remote M-data terminal) which is connected with the system via PSDN, an operator can maintain the data of subscribers within his region.

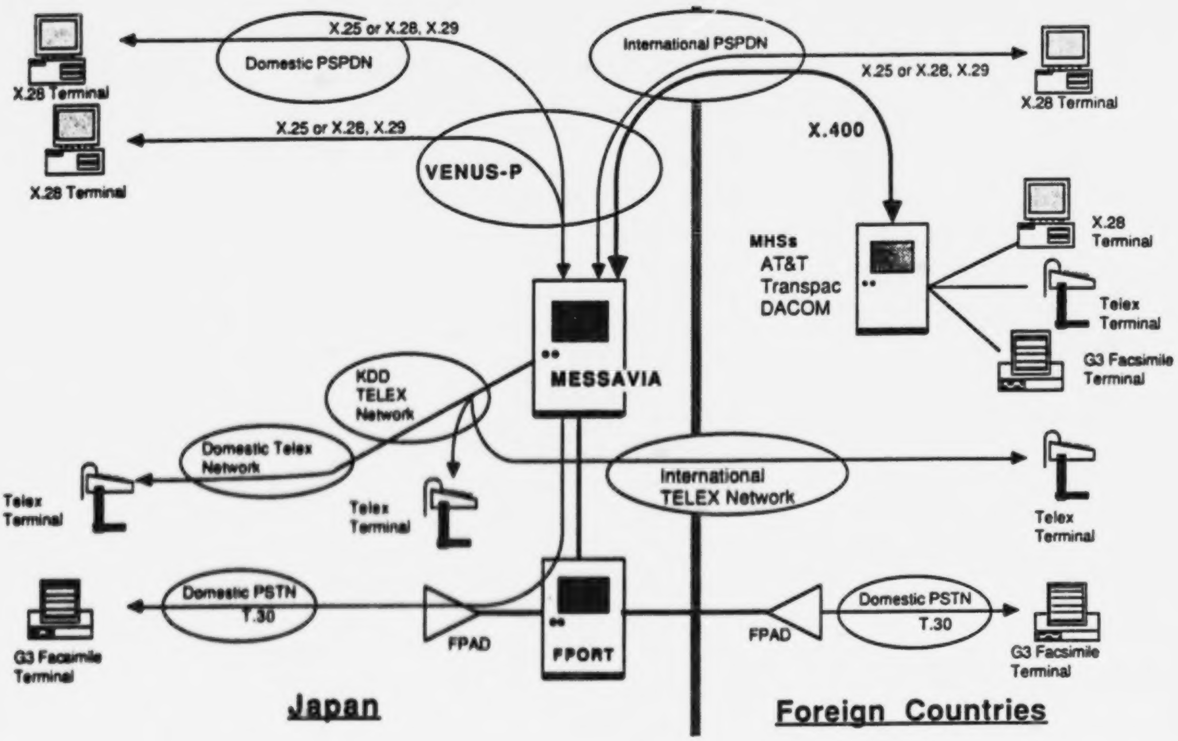

X.25 or X.28, X.29
Domestic PSPDN
X.28 Terminal
X.25 or X.28, X.29
X.28 Terminal
VENUS-P
International PSPDN
X.25 or X.28, X.29
X.28 Terminal
X.400
MHSs
AT&T
Transpac
DACOM
X.28
Terminal
Telex
Terminal
G3 Facsimile
Terminal
MESSAVIA
KDD
TELEX
Network
Domestic Telex
Network
Telex
Terminal
Telex
Terminal
International
TELEX Network
Telex
Terminal
Domestic PSTN
T.30
FPAD
FPORT
FPAD
Domestic PSTN
T.30
G3 Facsimile
Terminal
G3 Facsimile
Terminal
Japan
Foreign Countries

Fig.1 Network Configuration of MESSAVIA

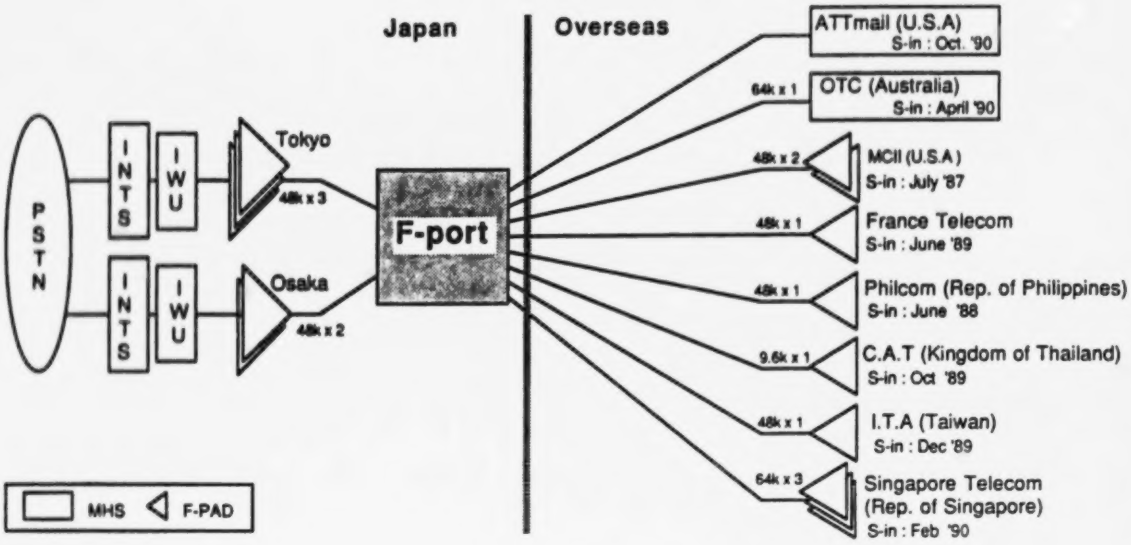

Japan
Overseas
PSTN
INTS
IWU
Tokyo
48k x 3
INTS
IWU
Osaka
48k x 2
F-port
ATTmail (U.S.A)
S-in : Oct. '90
64k x 1
OTC (Australia)
S-in : April '90
48k x 2
MCII (U.S.A)
S-in : July '87
48k x 1
France Telecom
S-in : June '89
48k x 1
Philcom (Rep. of Philippines)
S-in : June '88
9.6k x 1
C.A.T (Kingdom of Thailand)
S-in : Oct '89
48k x 1
I.T.A (Taiwan)
S-in : Dec '89
64k x 3
Singapore Telecom
(Rep. of Singapore)
S-in : Feb '90
MHS
F-PAD

Fig.2 Network Configuration of F-Port

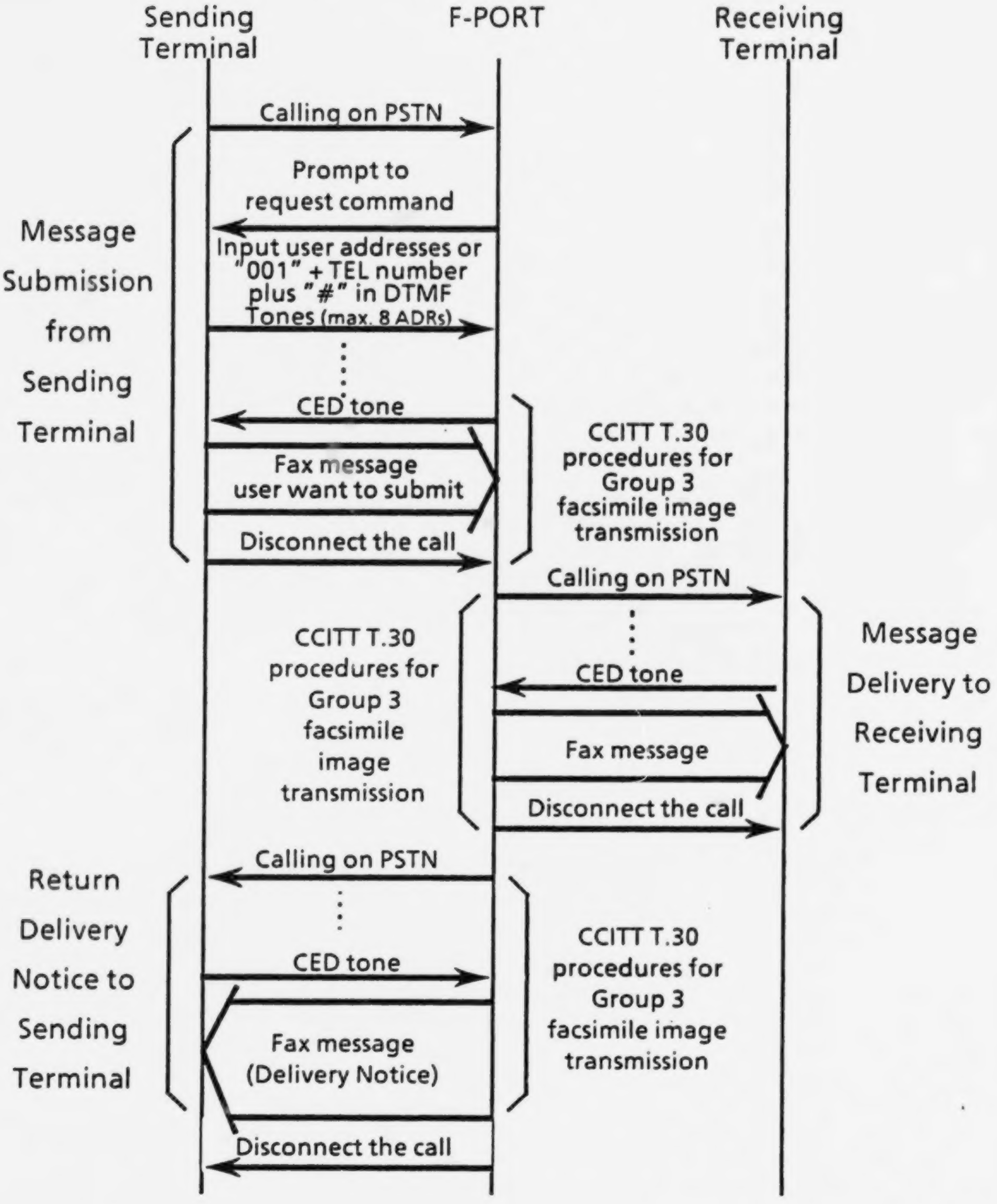

Sending Terminal
F-PORT
Receiving Terminal
Calling on PSTN
Prompt to request command
Message Submission from Sending Terminal
Input user addresses or "001" + TEL number plus "#" in DTMF Tones (max. 8 ADRs)
CED tone
CCITT T.30 procedures for Group 3 facsimile image transmission
Fax message user want to submit
Disconnect the call
Calling on PSTN
CCITT T.30 procedures for Group 3 facsimile image transmission
Message Delivery to Receiving Terminal
CED tone
Fax message
Disconnect the call
Calling on PSTN
Return Delivery Notice to Sending Terminal
CED tone
CCITT T.30 procedures for Group 3 facsimile image transmission
Fax message (Delivery Notice)
Disconnect the call

Figure.3 Exaqmple of message delivery sequence

5. G4 Facsimile Access System

5.1 Outline

G4 facsimile terminal was standardized in CCITT '84 recommendation T.6 and T.73. The interconnectivity among terminals produced by different Japanese manufacturers was confirmed at the end of 1985.

Considering that CCITT SGVIII started the study MHS access protocol for Telematic terminals (G4 facsimile, TTX and mixed mode terminals) in the study period 1985-1988, KDD decided to develop the system to accommodate G4 facsimile terminals and finished it in 1988.

By interworking with MESSAVIA system and F-PORT system, G4 facsimile access system can provide not only communication among G4 facsimile terminals but also multi-media communication between G4 and G3 facsimile terminals and between ASCII terminals and G4 facsimile terminals. This multi-media communication environment was demonstrated in "5th International Conference on the Application of Standards for Open Systems Interconnection" on March '89 in Tokyo.

5.2 Service

The service for Group 4 facsimile terminals has not started yet in KDD. This system, however, can provide G4 facsimile terminal users with the following service elements:

- Delivery among G4 facsimile terminals
- Delivery to/from G3 facsimile terminals
- Delivery from E-Mail users
- Multi-destination delivery
- Delivery/Non-delivery notification
- Receipt/Non-receipt notification
- Abbreviated address
- Group address
- Mailbox retrieval
- Bulletin board
- Input message cross reference report
- Output message cross reference report

5.3 Network configuration

The possible network configuration is shown in Fig. 4.

5.4 Functions

5.4.1 Basic functions

(1)G4 facsimile terminal access to the MHS: The G4 facsimile terminals access the MHS via PSDN; the originator will be authenticated by his calling DTE address. The access protocol between G4 facsimile terminals and MHS accords to CCITT Recommendation T.330. This implies that G4 facsimile terminals which access to the MHS also has to support T.330 protocol.

(2)Delivery among G4 facsimile terminals: For sending a message to G4 facsimiles, either of the following addresses are to be specified;

a)unique UAID: to specify a subscribed user

b)X121 address: to specify an arbitrary G4 facsimile terminal. (In this case, a message will be delivered as a normal document without using T.330 procedure.)

When specifying the recipient address, the originator can request delivery notification and/or receipt notification per recipient.

The conversion on resolution and paper size can be done in this system.

T.330 message submission and delivery procedures are illustrated in Fig. 5.

If a recipient has the mailbox, he can retrieve messages according to T.330 procedure.

(3)Delivery to/from G3 facsimile terminals: This system can be connected with G3 facsimile S&F system (e.g. F-PORT) using X.400 interconnection.

For sending a message to G3 facsimiles, either of the following addresses are to be specified;

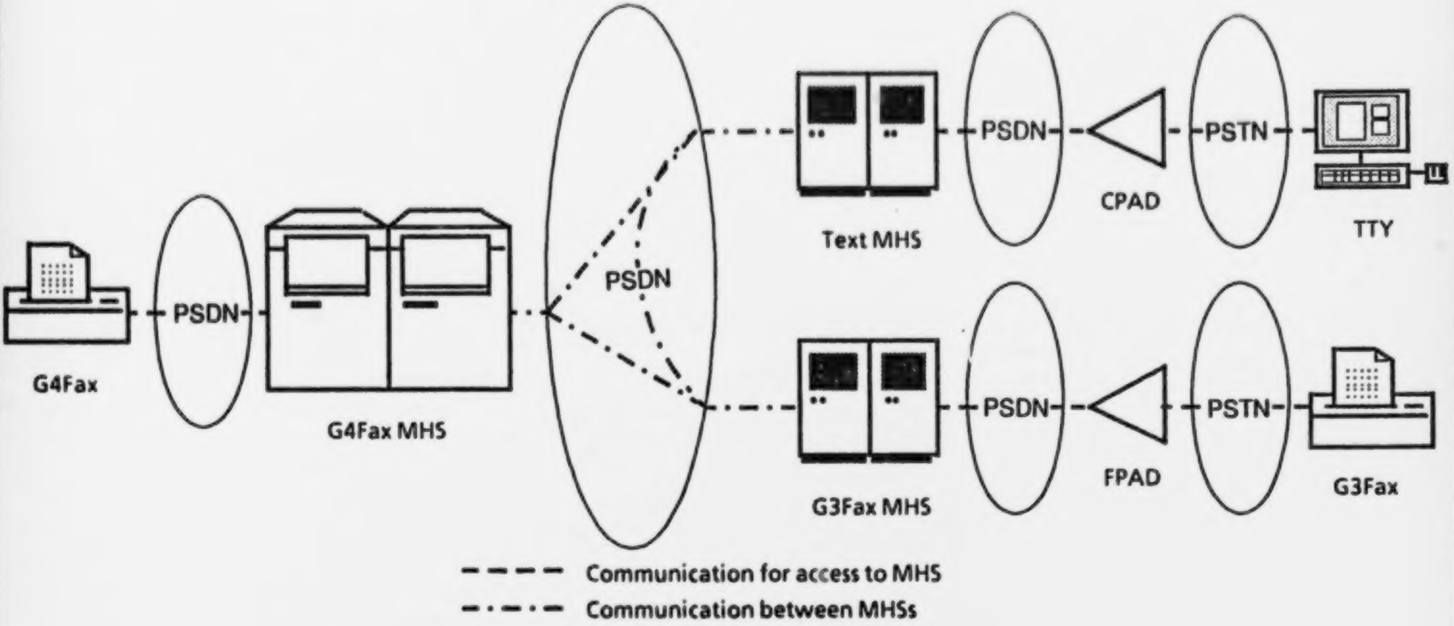
a)unique UAID: to specify a subscribed user of F-PORT

b)X121 address: to specify a arbitrary G3 facsimile terminals.

(In this case, X.121 address is composed of prefix'9' and E.163 telephone number.)

For the opposite direction, a G3 facsimile S&F service user (e.g. a F-PORT user) can send a message to G4 facsimile terminals using the addresses stated in item(2).

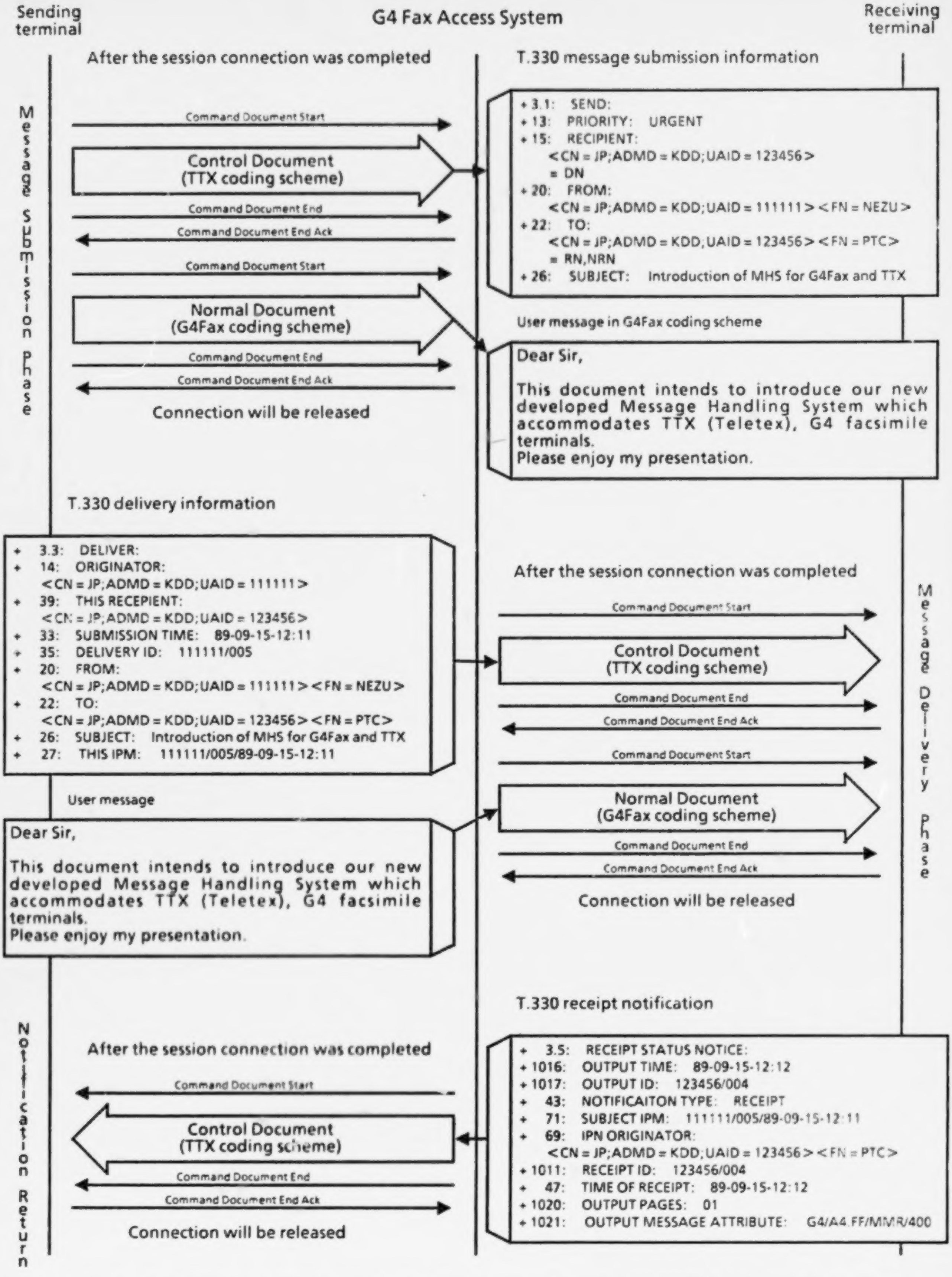
The conversion between G4 facsimile coding(T.6) and G3 facsimile coding(T.4) can be done in this system.


PSDN
PSDN
PSDN
PSDN
PSTN
PSTN
G4Fax
G4Fax MHS
Text MHS
G3Fax MHS
CPAD
FPAD
TTY
G3Fax
Communication for access to MHS
Communication between MHSs

Legend

CPAD:Character PAD
G3Fax:Group 3 facsimile terminal
PSDN:Packet Switched Data Network
MHS:Message Handling System
FPAD:Facsimile PAD
G4Fax:Group 4 facsimile terminal
PSTN:Public Switched Telephone Network
TTY:Teleprinter terminal

Figure.4 Possible network configuration for G4 facsimile access


Sending terminal
G4 Fax Access System
Receiving terminal
Message Submission Phase
After the session connection was completed
Command Document Start
Control Document (TTX coding scheme)
Command Document End
Command Document End Ack
Command Document Start
Normal Document (G4Fax coding scheme)
Command Document End
Command Document End Ack
Connection will be released
T.330 message submission information
User message in G4Fax coding scheme
T.330 delivery information
User message
Message Delivery Phase
After the session connection was completed
Command Document Start
Control Document (TTX coding scheme)
Command Document End
Command Document End Ack
Command Document Start
Normal Document (G4Fax coding scheme)
Command Document End
Command Document End Ack
Connection will be released
Notification Return
T.330 receipt notification
After the session connection was completed
Command Document Start
Control Document (TTX coding scheme)
Command Document End
Command Document End Ack
Connection will be released

T.330 message submission information

+ 3.1: SEND:
+ 13: PRIORITY: URGENT
+ 15: RECIPIENT:
<CN = JP;ADMD = KDD;UAID = 123456>
= DN
+ 20: FROM:
<CN = JP;ADMD = KDD;UAID = 111111><FN = NEZU>
+ 22: TO:
<CN = JP;ADMD = KDD;UAID = 123456><FN = PTC>
= RN,NRN
+ 26: SUBJECT: Introduction of MHS for G4Fax and TTX

User message in G4Fax coding scheme

Dear Sir,

This document intends to introduce our new developed Message Handling System which accommodates TTX (Teletex), G4 facsimile terminals.
Please enjoy my presentation.

T.330 delivery information

+ 3.3: DELIVER:
+ 14: ORIGINATOR:
<CN = JP;ADMD = KDD;UAID = 111111>
+ 39: THIS RECEPIENT:
<CN = JP;ADMD = KDD;UAID = 123456>
+ 33: SUBMISSION TIME: 89-09-15-12:11
+ 35: DELIVERY ID: 111111/005
+ 20: FROM:
<CN = JP;ADMD = KDD;UAID = 111111><FN = NEZU>
+ 22: TO:
<CN = JP;ADMD = KDD;UAID = 123456><FN = PTC>
+ 26: SUBJECT: Introduction of MHS for G4Fax and TTX
+ 27: THIS IPM: 111111/005/89-09-15-12:11

User message

Dear Sir,

This document intends to introduce our new developed Message Handling System which accommodates TTX (Teletex), G4 facsimile terminals.
Please enjoy my presentation.

T.330 receipt notification

+ 3.5: RECEIPT STATUS NOTICE:
+ 1016: OUTPUT TIME: 89-09-15-12:12
+ 1017: OUTPUT ID: 123456/004
+ 43: NOTIFICAITON TYPE: RECEIPT
+ 71: SUBJECT IPM: 111111/005/89-09-15-12:11
+ 69: IPN ORIGINATOR:
<CN = JP;ADMD = KDD;UAID = 123456><FN = PTC>
+ 1011: RECEIPT ID: 123456/004
+ 47: TIME OF RECEIPT: 89-09-15-12:12
+ 1020: OUTPUT PAGES: 01
+ 1021: OUTPUT MESSAGE ATTRIBUTE: G4/A4.FF/MMR/400

Figure.5 Submission, Delivery and Notification return procedure on T.330 access protocol

(4)Delivery from E-Mail users: This system can be connected with E-Mail system (e.g. MESSAVIA) using X.400 interconnection. An E-Mail user (e.g. a MESSAVIA user) can send a message to G4 facsimile terminals using the addresses stated in item(2). The conversion from IA5 to G4 facsimile coding(T.6) can be done in this system.

5.4.2 Additional functions

The following function are provided for the same purpose as in F-PORT(see section 4.4);

- Input message cross reference report
- Output message cross reference report

5.4.3 CCITT recommendation T.330

This recommendation specifies Telematic terminal's access protocol to IPMS (Interpersonal Messaging System). Access protocol procedure specified in T.330 covers not only P1 protocol elements but also P2 protocol elements. These elements are to be encoded in T.61(TTX) character string and to be transferred to the MHS in control document which is the document specified on T.62 session protocol. (The facsimile image data is transferred in normal document.) Since G4 facsimile access system was developed in parallel with CCITT SGVIII study, KDD made a lot of contributions to produce Rec.T.330.

6. New generation MHS

6.1 Outline

Considering the followings, KDD is now developing the next generation MHS system.

-There are so different understandings and implementation of CCITT X.400 recommendation.

-It is quite possible that the variation of media increase and that the X.400 network become complex.

-MHS service can be provided by any organization and would become very competitive.

6.2 Development policy

When starting the development, KDD set up the following policies.

-to design and produce the software by KDD

-to use widely available hardware

-to easily accomodate a new medium

-to easily increase the system capacity

-to provide a user with the uniform service to every destination

-to develop it economically

6.3 Features

-to keep the interconnectivity with the existing various systems in the world.

1)different notifications

2)different message size limitation

3)different coding schemes

4)different delivery mechanisms

-to minimize the possibility of non-delivery /non-receipt

1)alternate recipient terminal assignment by the originator

2)alternate recipient terminal assignment by the recipient

3)specifying maximum delivery delay

-to enhance user interface

1)one stage dialling

2)different message formats

-to enhance operation functions

1)traffic distribution on return traffic volume

2)re-routing on a circuit failure

3)detection of a stagnant message

4)message cancellation

7. Conclusion

KDD applied the X.400 system to E-mail and G3 facsimile S&F service. Eventually, many more application data will be transferred via global X.400 network; for example CCITT SGVII started the study of EDI data transfer on X.400 system. Although the X.400 system is applied to many fields, it can not stay just the S&F system. That is, the service based on X.400 needs to be attractive from the viewpoint of commercial and users not from it of the technical only. Furthermore, the quality of service, such as delivery delay, possibility of non-delivery, would become the very important aspects to be considered for this kind of enhanced service.

Opportunity for the TSPs to Accelerate Market Growth of Emerging Network Information Services Applications

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1. ABSTRACT

Network Information Services Applications include Electronic Mail, EDI, Conferencing, Imaging, Store-and-Forward FAX and Telex, VTX, Informatin Gateways, Voice Messaging, Audiotext, and Corporate E-mail integration. While none of these technologies are new, the Telecommunication Service Providers are uniquely positioned to popularize these services so that they become the most accepted way for individuals and businesses and enterprises to exchange information.

2.0 Introduction

Information is power. The ability to receive and send information in a timely manner allows individuals and businesses to control their destinies. Global voice service is now an accepted medium for communication. Factors contributing to its popularity include:

- o accessibility by individuals and businesses
- o global connectivity
    - ease of use
    - low tech
    - inexpensive
    - simple billing

The infrastructure that the Telecommunication Service Providers have instituted in this century for voice service can be the basis for new integrated services for individuals and for corporations and governments.

3.0 The Applications

In the last 10-15 years, there has been a slow, steady growth of Network Information Services. Initially, electronic mail was used for internal corporation communication. The most common technology used for communication outside the corporation was FAX and Telex.

Concurrently, increasingly less sophisticated users wanted adhoc access to information databases. This need was satisfied by the introduction of high-level data base retrieval languages and through VTX.

Companies were also developing on-line purchasing systems to manage their costs and on-line ordering systems to gain a competetive edge. These first inter-company systems were the forerunners of today's EDI services.

The advent of the PC created demands for new functions and, more importantly, for the integration of these network information systems. It also created the beginning of a public market. People who learned the technology at work or at school, wanted to apply it for home use.

The evolving marketplace is looking for an integrated service which allows transport and delivery of ad hoc messages, business documents, images, and structured information. It must support a variety of devices. The successful services of the future, therefore, will offer a variety of integrated services such as:

- o Electronic mail
- o EDI

- Conferencing
- Imaging
- FAX Store-and-Forward
- FAX and Telex Interfaces
- VTX
- Information Gateways
- Information Database access
- Voice Messaging
- Audiotext
- Hard copy Delivery
- Interconnection to in-house systems

4.0 The Market

There are three large market segments for NIS: Commercial, Government, and Mass Market.

4.1 Commercial

The commercial market may be subdivided into large businesses and small/medium businesses.

4.1.1 Commercial--Large Businesses

The most crucial business need for large corporations is the ability to react more quickly to their changing market requirements and improve customer satisfaction. The corporate culture is changing from the traditional hierarchical structure to a more decentralized, yet integrated structure.

Information exchange is seen as an important tool in operating more effectively in this more dynamic structure.

In the early 1980s, corporations looked to public e-mail providers to achieve corporate electronic mail. Today, large corporations utilize multiple in-house e-mail systems. The problem with this solution is that the multi-vendor mail systems are not integrated into one seamless corporate e-mail system. The TSPs themselves are facing this issue today.

While corporations today are more likely to look to computer vendors to provide multi-ivendor e-mail integration for their in-house systems, they still need the public e-mail providers for:

- locations remote from corporate headquarters that are not equipped with sophisticated computer and communications equipment. (Micros are generally the most advanced systems at these locations.)
- communiciation with people outside the corporation. (Users on a public e-mail system do not have to be given direct access to a corporation's in-house system, thereby eliminating potential security and administration problems.)
- international locations.

Large corporations view the public e-mail system as extensions of their own in-house corporate e-mail system. Corporations expect the public e-mail system to support interchange between different vendor messaging systems.

Corporations wish to have access to the public e-mail system via a local call from almost anywhere in the world. The public e-mail system should be able to interface to a variety of minis, micros, mainframes, dumb terminals, Telex and FAX. Also, corporations wish to integrate public e-mail systems with their internal messaging systems.

Just as today there are usually many TSPs involved when a long distance voice phone call is made; it can be expected that in the future the TSPs will have to smoothly integrate their individual NIS offerings with each other.

The Open Systems Interconnect (OSI) is a set of recommendations formulated to address the communications problems in multivendor computing environments. Most vendors currently subscribe to the concept of the Open System Interconnect. Inevitably, OSI will be the base upon which all future global messaging systems will be built. OSI is the only internationally recognized standard being developed for interconnecting and inter-working different types of computers. OSI provides the pattern to transfer electronic mail messages between systems through a series of layered, standard definitions for communications.

The X.400 series within OSI are perhaps the most important message standards currently being developed.

In summary, public e-mail systems are viewed as strategic components of corporate e-mail systems. The use of public e-mail systems by large corporations is still a growing market.

4.1.2 Commercial - Small/Medium Businesses

Today, the small/medium businesses are an untapped market for public electronic mail and other NIS services. This market has generally been ignored by the large commercial public e-mail providers. One reason why the current large public e-mail providers have not pursued this market is that it requires a regional sales force and regional support. This is an advantage for the TSPs since they already have a working relationship with the small and medium-sized businesses in their regions.

Another reason that the small/medium business market has been de-emphasized for so long is the question of whether the small and medium-sized businesses have a need for electronic mail and other Network Information Services.

There are trends that are encouraging the NIS market for small/medium businesses:

- A small/medium business is generally contained within a region but is often distributed across the region. This business has the same communications and integration problems as large corporations that are distributed nationwide and internationally. Since the businesses are already used to working with the TSPs to solve their past communication problems, it would be natural that they would turn to the TSPs for a messaging system. The TSP could solve the entire problem by providing software for their micros, a network, and a large central e-mail system.
- Small/medium businesses often buy turn-key micro-based systems for their business needs. If the TSPs provided public interfaces into their public e-mail systems, these niche vendors could incorporate the TSP e-mail system as part of their turn-key packages.
- Many medium-sized businesses need to communicate with their users. Examples of such vertical markets are:
  - hospitals (doctors, nurses, administrators)
  - universities (students, professors, administrators)
  - banks (small businesses, professional offices)
  - regional businesses (local distributors)

The features required for a public e-mail system that was concentrating on the small/medium business would include:

- accessibility by users via a local call
- an open system architecture that would include public interfaces into the TSP system. Obviously, there would be adequate security to ensure that only authenticated users had access to the e-mail system.
- access to a wide variety of terminals and micros. (There would generally be little requirement for access by mainframes.)

In addition to messaging, these businesses also have a need for information gateways. They would need access to the large scale information providers for general business information and perhaps niche information providers for special interest topics.

An example of the type of information that might appeal to small/medium businesses is technical computer information. Not having the leverage of large corporations, small/medium businesses often feel that they do not get adequate technical support from some of the computer vendors. Roundtables and computer software exchange information providers would offer them with much-needed information. Also, small/medium companies tend to be regional and, therefore, are very interested in the information provided by regional and local information providers on local events and issues. NIS allows users to communicate with local businesses and institutions such as poison prevention centers, schools, universities and hospitals.

In summary, the small/medium business market is slow growing but very real. It is following in the footsteps of large corporations. First, the emphasis of small/medium businesses is on simply automating many of their manual systems. The next step is to provide for communications via computers. E-mail becomes an effective form of intra-company and inter-company communication. Access to wide range of databases, many of them public, becomes important. These small businesses will respond to NIS services oncethey become available.

4.2 Governments

In many ways the needs of governments are very similar to those of large corporations. Governments need to integrate their various agencies and departments. Most large projects and programs span multiple agencies/departments and require the agencies to exchange information and documents. Governments also need to communicate with private vendors. Just as EDI has gotten to be important for large businesses to exchange business documents with their suppliers, so also governments need to be able to deal productively with their suppliers.

A number of countries (governments) are looking at EDI as a necessity as they themselves are trading economies. A good example of this is Singapore which now has had a production EDI system for a year which links many Government Ministries and major companies within Singapore. Other countries. e.g. Hong Kong, Malasia, etc. are looking at doing something similar.

Governments also need to have a medium through which they can provide information to the public and also a medium for the public to more effectively interface with the government.

EDI could be used for governments to do business with their suppliers; E-Mail, VTX, Voice Messaging and Audiotext for communciation with the public at large and with providing information to the public.

In emerging countries such as in the Far East, investment in TSPs and NIS is a major goal to ensure the growth of their countries.

4.3 Mass Market

The mass market should actually be subdivided into two groups: computer equipped homes and non-computer equipped homes. Those homes that have PCs, terminals, etc. may be using the equipment as part of their business office that is located in the house or they may be using the computer equipment for recreational activities. In either case, an integrated offering of information providers and electronic mail would be very attractive to them.

The market for non-computer equipped homes is new and their needs are quite different.

4.3.1 Mass Market - Computer Equipped Home Mass Market

The market for information gateways and electronic mail to computer equipped homes is here today. There has been a tremendous rise in the last couple of years for low- speed modems (300, 1200, 2400 bps). Home users found that, although the PCs were useful tools at home and were a good source of entertainment, they wanted something that would provide access to the outside world. A growing number of home PC owners have modems and software that will allow them to communicate with other systems.

Companies that provide a complete integrated package of information providers and electronic mail are attracting hundreds of thousands of users. Users are first attracted to the service by the business and technical information providers. Generally though, the heaviest usage of the system is in the conferences and roundtables, interactive games, "chat" lines and e-mail. The general requirements that users have for this type of system are:

- o a large variety of information providers
- o good quality (good response time, reliability, and availability)
- o the ability to easily move from one information provider and service, such as e-mail, to another service
- o low cost
- o ease of use.

To be successful, the TSPs will need to offer integrated systems so that they are as easy to use as present voice services.

The TSPs are also in a position to emphasize local information providers.

These information providers are generally not found in the services that are in the market today.

Knowing that all the users are from the local region may also be an attractive feature. Users on these services get to know one another from the games, roundtables, and conferences. E-mail useage grows as the users begin to communicate among themeselves. Occasionally information providers schedule live events, e.g., conferences to allow users to meet the experts who have provided the information for the databases. This is easier to coordinate if it is a regional service rather than a national/international service.

4.3.2 Mass Market - Non-Computer Equipped Home Mass Market

Today, there is no market for NIS services to non-computer equipped homes. It would require a cultural change in all countries. While this is not a viable market for the TSPs in the USA today, it has the greatest potential for the future.

The Minitel experience in France is a prime example of the success of NIS services to the mass market.

Also there is more FAX utilization in the Far East and Japan than in any other part of the world. This is again an indication of the quick use and acceptance of new technology. Also, FAX facilitates the exchange of messages among languages with unique character sets such as Chinese, Japanese, Korean, etc.

The cultural change for this market to take off in the USA is actually taking place. Everyone is being exposed to computers, such as automated teller machines, grocery store checkouts, computerized directories in shopping malls, and computers in the classrooms.

The Victoria Project, started by Pacific Telesis, may be an additional indication that this market could be a very real opportunity for the TSPs. In the project, users were provided with equipment in their homes that gave them access to NIS services. The system was very actively used. It did prove, however, that the users found the technology acceptable.

Possible requirements for this market might be:

- o the TSPs would lease and service equipment for the home users
- o all the information providers and e-mail systems must be seamlessly integrated
- o information providers (principally regional and local) would absorb most of the charges of the service
- o end-users would only pay a nominal fee for usage
- o the systems would be extremely user friendly
- o simple billing procedures would be involved.

The growth in e-mail usage in this market would initially be secondary. It would start out as traffic between the information providers and/or local business and the end-users. Simplicity of access would encourage the end-users to use e-mail to communicate with one another.

The TSPs are in a unique position to take the lead and market share in this marketplace. Just as the telephone companies created the market for home telephones through simple inexpensive service and leased equipment, they can do the same for mass market NIS services.

5.0 Current Providers:

In most countries, the PTTs have a monopoly on the TSP market. However, there are signs today of commercial companies entering the market in South Korea, Taiwan, Singapore, etc. and offering competition to the PTTs. In the USA, there is no PTT. The large commerical providers today in the U.S.A. are targeting two market segments: large businesses and the computer-equipped mass market. Prominent providers/systems targetting large businesses are: AT&T, Dialcom, Easylink, Infoplex, IPsharp, MCI, Notice, OnTyme, GEIS, and Telenet.

In Europe, it is expected that the PTTs will also become more aggressive in offering NIS to support the changes that are expected in 1992. As businesses expand across national boundries, they will require enhanced communication technology.

The providers that are targetting the computer equipped mass market are Compuserve, Source, and GEIS' Genie.

They rely mainly on mass media advertising to attract users.

The TSPs in the U.S.A., in Europe and the Pacific Rim are now also beginning to offer NIS services. Digital Equipment Corporation has been working with Pacific Telesis, U.S. West and with the German Bundesposte to design and implement NIS services for their customers. Digital worked with Pacific Telesis to develop the Telecom/400 messaging platform. This platform has been used as the basis for developing NIS services with Pacific Telesis, U.S. West and the German Bundesposte and is being offered by Digital Equipment Corporation to other TSPs.

The TSPs recognize that NIS is a natural extension to the primarily voice-based services and leased line services that they have been offering their clients. The first step that the TSPs took in offering data services was to offer packet-switched networks for data transport. NIS incorporates networking capabilities as well as communication intensive applications.

5.1 Current Limitations to Market Growth

There are a number of factors that are limiting the growth of NIS. For the Commercial Providers the major problem is the cost of sales and support. The Commercial Providers have extensive network reach. Many advertise that they are reachable via a local call from 90% of the phones in the Western and Pacific Rim countries. Their sales force is much more limited. To maximize the effectiveness of their sales and support organizations, they target the large corporations. One sale results in substantial revenue. Also the primary NIS services that they offer- EDI, global e-mail, are mainly needed by the large corporations.

The large commercial providers do not have an effective means of reaching the medium and small businesses and, therefore, they are often ignored by the commercial providers.

Commercial providers use advertising in popular publications to attract computer-equipped home users. Newsletters and magazines that focus on PCs are particularly effective.

In the last 10 years, the commerical TSPs have received about two billion dollars for public e-mail services in the United States. The TSPs have traditionally concentrated on specific geographic locations. Were the TSPS to focus on large businesses, they would be hampered by their geographic reach in terms of their networks and their sales and support organizations. In Europe, the PTT's have solved the problem of extended reach somewhat by creating the business and technical links that result in a Europe-wide system.

Ease of use is a major complaint among many users of NIS services. The strength of NIS is that it is the integration of many different applications, systems and databases. Unfortunatly the rich diversity manifests itself as complexity for the user. As the user navigates from one service to another, he often has multiple log-ons and multiple command syntax to master. Even the basic command to exit the service differs from one service to another.

Although this is rapidly changing, a lot of people still have computer phobia. There is discomfort in using the technology. The NIS services today still often assume a certain computer sophistication. Because a keyboard also is still an essential part of many of the devices used for interacting with the NIS systems, many users view it as an office tool used by the clerical staffs. A certain level of typing skill is often expected of users of these systems.

The difficulty that business users encounter in using NIS is the inaccessablity of NIS from their existing office automation systems. The business user would like to use the same devices, the same interfaces that they are using in their offices to obtain NIS information.

The perception today is often that the NIS offerings are too expensive for the value received. Compared to the cost of phone calls or postal mail, NIS servies are expensive. The equipment needed to access NIS services (PCs or mainframe hook-up costs) is expensive. The popularity of FAXes and Telexes underline the importance of low-cost, low-tech devices. The major problem of Telexes and FAXes is that the recipient cannot revise the documents that they get. The belief that FAXes are low cost is also somewhat deceptive because it does not account for the human effort that it often takes to send FAXes if devices are busy or there are long distribution lists. The Store-and-Forward FAX system, which is an NIS component would provide the benfits of a conventional FAX system with the added benefit of freeing the user from having to establish a real-time link to each of the recipients' machines.

There is question about the economic viability of the marketplace. With so many providers already in the market, NIS is being offered at commodity prices. Certainly the TSPS will have to approach the market with innovative ideas and new approaches in order to be successful.

6.0 Vision of the Evolving Market:

It is clear that the way in which the world is communicating is changing. Information, if it is of any value, needs to be shared. Geographic, time, organizational, technology boundries need to eliminated.

It should be easy to mix and match technologies. A message may contain text, voice and graphics. A document may be produced by a sophisticated computer program or a word processor but it should be possible to transmit it to a simple Telex device or hand deliver via hard copy output from a printer. The sender should be able to produce and send the information at his convenience; the recipient should be able to retrieve the document and process it at his convenience.

For businesses, this ability to quickly exchange information and to have global reach results in a competitive edge for that business. Every industry has identified its major business goals to be: ability to more quickly respond to changing markets; shorter time to market; better service to their users. By the ability to retrieve and exchange information, the NIS services help businesses to achieve their primary goals.

The same techonolgy that enables businesses to be successful can also be used by individuals to manage their personal lives. Private social, and business needs can be met through NIS servies. NIS allows individuals to get information about topics of interest to them via access to databases and gain knowledge of upcoming events. NIS provides individuals with the ability to communicate with others who share the same interests.

The fact that TSP's tend to be regional is an advantage to attracting the the mass market. Individuals can find out about events sponsored by local businesses, such as sales, open houses, exhibits. They would have access to financial institutions and data bases such as stock reports and mortgage rates and banking options.

A number of countries, particularly in the Far East, who are expanding their networks to support their economic growth plans, do so by using the latest technologies and hence they have no migration concerns, unlike those western nations that have established systems in place.

7.0 Unique Positioning of the TSPs

The TSPs are well positioned to take advantage of the NIS opportunities. They have already overcome many of the obstacles that often face a new company trying to break into a competitive market. Before buying a product or service from a company, a customer must feel confident that the company is able to deliver the product or service, and that the company's future ability to handle problems or add new enhancements as needed is secure. The TSP customers are looking for solutions that will solve their immediate needs and will also be flexible and responsive as their business needs change.

The TSPs have a long-standing relationship with their business and home-resident customers. The telephone service is accepted as a utility because it is always there, always works properly, and is reasonably priced. Customers rely on the local support that has always been available from the TSP companies. This local support is especially appreciated by small to medium-size companies and by consumers, who are often ignored by companies who cater primarily to Fortune 500 clients.

The importance of an established customer base should not be overlooked. Existing customers are traditionally more receptive to new services than are new customers. With an existing customer, the business relationship has already been established and the procedure for selling, delivering, and billing is already in place.

Consolidated billing reduces the cost for the TSP customer to do business. This is a definite value-added feature the TSPs can offer their clients as part of the new services they will be providing. Billing can also be a cost effective answer to marketing. Because of billing, the TSPs have a channel for sending information on new services and promotions.

There is a natural synergy between offering data transmission, which the TSPs have been able to provide for some time, and NIS, which is a new service for the TSPs. Electronic mail requires a reliable network that is easily accessible by many concurrent users. At the same time, customers who need a data network also view electronic mail as one of the services available from a value-added network provider. Features such as protocol conversion will be important for data transmission as well as electronic mail. The growth of one business (electronic messaging, data transmission) will influence the growth of the other.

Many of the TSPs are combining the experience and technology that they already have in place with the experience and technology offered by computer vendors. The TSPs are partnering with the vendors to design and implement Network Information Services. Digital Equipment Corporation is presently working with TSPs in the Pacific Rim, Europe and the U.S.A.

Through such sharing of expertise and established systems, the Telecommunication Services Providers will acclerate the market growth of emerging Network Services Applications globally.

TELECOMMUNICATIONS AND INTERNATIONAL BANKING AND FINANCE: ASIA-PACIFIC PERSPECTIVES

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1. ABSTRACT

The growth of telecommunications and banking and finance in the Asia-Pacific region is examined in the context of the emerging internationalization of production. Banking and finance is selected as a case study industry, given that it has rapidly internationalized production and is a major user of international telecommunications. The shift towards twenty-four hour trading in financial services has important implications for international telecommunications in the Asia-Pacific region, since global financial markets generate heavy international telecommunications traffic flows.

2. INTRODUCTION

Developments in telecommunications and banking and finance in the Asia-Pacific region are examined in the context of the emerging internationalization of production. Banking and finance is selected as a case study industry, given that it has rapidly internationalized production and is a major user of international telecommunications. The shift towards twenty-four hour trading in financial services has important implications for international telecommunications in the Asia-Pacific region, since global financial markets generate heavy international telecommunications traffic flows.

Internationalization of the banking and finance industry has contributed to the growing importance of trade in financial services, which in turn is closely intertwined with the rise of foreign direct investment: many financial services cannot be traded unless firms are able to physically provide services in the host country. The situation is further complicated by the fact that a significant number of international service transactions take place on an intracorporate basis within transnational corporations (TNCs) and are unlikely to enter statistics on trade in services.

2.1 NATURE OF THE INTERNATIONALIZATION OF PRODUCTION

The term internationalization of production is often used but rarely defined in studies examining the growth of the international economy. In this paper a fairly narrow definition of the internationalization of production is taken: it is defined as the extent to which an industry or a firm has moved towards the global integration of production, marketing and finance. The focus is on the supply rather than the demand side. This is not to suggest that the supply side is more important; rather it is not possible to consider all aspects of the term thoroughly.

The internationalization of production may be seen at an intracorporate and an intercorporate level (Langdale, 1989b). At an intracorporate level many large TNCs are integrating their production, warehousing, marketing and finance on a global basis. In addition, the internationalization of production may be seen at an intercorporate level. Linkages between firms within an industry (e.g., banking and finance and transport) are growing rapidly; improved telecommunications systems are needed to facilitate information flows. In addition, linkages between firms in closely related sectors, such as futures, securities and foreign exchange trading are growing rapidly.

The internationalization of production is leading to complex patterns of competition and interdependence in telecommunications and service industries within the Asia-Pacific region as well as between the region and major industrialised countries. While much attention has been focused on the international trade rivalry between the U.S. and Japan, the emerging interdependencies between the two economies has been neglected. A massive increase in the volume of Japanese foreign investment in the U.S. has occurred in the 1980s; the U.S. accounted for 45 percent of total Japanese foreign direct investment in 1986 (Japan External Trade Organization, 1988, 5). This growing interdependence may be also be seen in the banking and finance industry in such areas as the entry of Japanese financial institutions into the U.S. and the growth of futures and securities trading involving both countries.

3. INTERNATIONAL TELECOMMUNICATIONS

The internationalization of production in a number of industries has meant that many large organizations are using telecommunications to integrate their international operations. The web of international information flows reflects and in turn facilitates the growing internationalization of production.

International telecommunications traffic in the Asia-Pacific region is growing rapidly, although it is still much smaller than that of the Atlantic region. There are major variations in the size and expected growth rates of domestic and international telecommunications markets in Asia-Pacific countries. Miglio (1988) estimates that the major sources of long-distance traffic in the Region were: the U.S. (34 percent), Japan (15 percent), Australia (11 percent), Hong Kong (9 percent), Singapore and South Korea (7 percent each), Taiwan (6 percent), Thailand, Philippines and Indonesia (each with 3 percent) and New Zealand (2 percent). He also estimated that the U.S.-Japan route was the largest with 30 percent of long-distance regional traffic, with the U.S. to East and Southeast Asia next with 28 percent of traffic.

The dominant role of the U.S. and Japan in Asia-Pacific telecommunications reflects their global economic status. Traffic between these two countries is likely to grow very rapidly, reflecting the growing interdependencies in the two economies and the progressive internationalization of many industries. While Japan is the world's second largest economic power and is growing rapidly, it currently occupies a relatively small position in international telecommunications. However, a survey of international telecommunications usage of Japanese firms found that the firms expected that international telecommunications would grow rapidly with the greatest increase to North America (with 51.1 percent of the total number of companies), Asia (29.6 percent) and Europe (16.3 percent) (Japan. Ministry of Communications, 1988). More generally, increases in Japanese international telephone traffic parallels the regional distribution of Japanese overseas investment.

There is very little information on international telecommunications usage by industry. I have reviewed elsewhere the usage of international leased circuits by industry categories (Langdale, 1989a and b). A survey of expenditure by Japanese users for international leased circuits found that the heaviest expenditures were by machinery manufacturers (principally electrical and electronics equipment), banks and financial firms and commercial (principally general trading) firms. Financial firms dominated voice (58 percent of total users) and medium- to high-speed (61 percent) circuits. North America accounted for 46 percent of the total number of Japanese medium- and high-speed circuits (Japan. Ministry of Posts and Telecommunications, 1988). While evidence from other major industrialized countries is limited, industries with the heaviest usage of international leased circuits are information equipment (electronics, computers and telecommunication) manufacturers and banking and finance. Many firms in these industries operate on a global basis.

There is considerable rivalry between Japan, Hong Kong, Australia and Singapore to become regional hubs for U.S. and to a lesser extent West European TNCs' international leased networks (Langdale, 1989a and b). Information on the number of U.S. Alternate Voice Data (AVD) circuits illustrates this rivalry, since a number of U.S.-based TNCs operating in the Asia-Pacific Region have sophisticated leased networks. Japan dominates U.S. AVD circuits with 310 circuits in 1987, Australia has 114 and Hong Kong 93. However, as users move to higher-speed services, the growth rate of AVD circuits is likely to decline. Of more importance is INTELSAT's high-speed IBS service; this was introduced between the U.S. and the Region in 1987: Japan was the largest destination with 53.3 percent of the total bandwidth for IBS circuits between the U.S. and the Asia-Pacific Region; Hong Kong had 29.1 percent and Singapore 16.1 percent.

4. BANKING AND FINANCE INDUSTRY

The banking and financial services industry is a highly internationalized industry. This internationalization may give large banks a major advantage, since if a bank is to have a significant presence in the three main financial markets of Tokyo, New York and London enormous amounts of capital are required. Size enables a bank to offer a wide range of financial services to companies which have themselves internationalised activities. Furthermore, mergers potentially allow large banks to share costs of adopting information technology. However, there is also scope for smaller banks in niche markets.

The emergence of giant transnational banks is of particular relevance in the Asia-Pacific region, given the internationalization of large U.S. and Japanese banks. A number of Japanese banks are currently expanding their operations and have targeted the U.S. The foreign share of domestic U.S. banking is likely to expand substantially during the 1990s. Once barriers to U.S. interstate banking come down, Japanese banks may use their strong California base to expand into retail banking throughout the U.S.

However, there are important differences within the banking and finance industry in the nature of internationalization. For example, foreign exchange trading (especially in U.S. dollars and Japanese yen) is highly international in scope and generates large information flows. A recent survey of foreign exchange trading has indicated that the international foreign exchange market has more than doubled in three years to average daily trading of over US $500 billion. While London has a daily trading volume of $187 billion compared to Tokyo with $115 billion and New York with $129 billion (Sesit, 1989), Tokyo's growth rate has been higher. Other Asia-Pacific countries such as Singapore, Hong Kong and Australia also have a significant turnover.

In contrast, the extent of the internationalization of securities trading is relatively limited. Nomura Securities, the world's largest security firm, is an interesting case study. Despite Nomura's global ambitions, the core business around which it was founded is the domestic retailing of stocks and bonds in Japan; Nomura has found it difficult to move from this base to create a global securities firm, particularly in New York (Wagstyl, 1988).

Yoshihisa Tabuchi, President of Nomura, has pointed out that people once thought that globalisation meant a simple integrated financial market (Schrage, 1989). In reality globalisation is neither simple nor integrated. Some parts of the securities business are inherently domestic (e.g., retail brokerage and mergers and acquisitions), so there is little point in trying to make them global. Tabuchi argued that globalisation is like putting together a jigsaw puzzle. Nomura may be very large and have tremendous resources, but it can't do everything by itself everywhere in the world. It has entered into alliances with small top-tier financial firms in local markets, primarily in the U.S. (Schrage, 1989). In common with many other Japanese firms internationalising their operations, Nomura intends to create three regional headquarters - the U.S., Europe and Southeast Asia, each of which will have independent operations. The Tokyo head office would coordinate activities among the three.

Nomura generates substantial international telecommunications traffic flows generated from its intra-corporate demands. In addition, Nomura Research Institute has started an international VAN service between Japan and the U.S. for securities firms. The service links the Japanese branch office of U.S. securities firms to their head office in New York allowing the U.S. companies to keep close track of securities operations.

5. TWENTY-FOUR HOUR TRADING IN FINANCIAL MARKETS

The role of twenty-four hour global trading in various financial markets has grown rapidly. This reflects the growing internationalization of the banking and finance industry and the ease with which international electronic funds transfer can take place. Factors which have encouraged the shift towards global trading are that the financial product is homogeneous, familiar and tradeable in large quantities, as for example trading in foreign exchange and U.S. Government bonds.

A fully internationalised banking and finance market would operate on a twenty-four hour basis with information flowing between different countries with minimal institutional and regulatory barriers. Clearly, this situation has not been reached and there are numerous barriers still in existence.

5.1 LINKING LOCATIONS: "FOLLOWING THE SUN"

One option that firms and markets have followed is to electronically connect different locations and transfer information as the working day follows the sun on a twenty-four hour basis. This option has been followed to a limited extent in foreign exchange, futures and securities trading. Foreign exchange trading tends to be most active during the time period when the East Coast of the U.S. and the Western European trading day overlaps. However, trading in the Asian Region has expanded rapidly in recent years, reflecting the growing importance of Japan and other Asian countries as international financial centres. It is important not to overemphasize the importance of this strategy, since it is practised only by some large firms. However, it has considerable importance for the Asia-Pacific region in terms of the rivalry between financial centres to be the Asian financial hub. This has close parallels with the earlier mentioned rivalry between Asia-Pacific countries to be the dominant hub location in telecommunications.

Large TNCs in banking and finance may link locations on an intracorporate basis. For example, a bank operating in New York City could pass on its foreign exchange position in various currencies to an office in Tokyo, Singapore or Hong Kong to cover the Asian trading day. At the close of trading, this office then passes its trading position to London for the European day and it finally comes back to New York for the cycle to begin again.

A similar system is in place for securities trading. A number of large securities firms trade on their own account or on behalf of clients twenty-four hours a day. To achieve this they have set up operations in the three time zones of Asia, Europe and America so one branch is always open. In fact, few institutions have achieved this goal. Merrill Lynch is one of the few securities houses which passes its book in U.S. government securities from one centre to another so that each in turn is responsible for trading the company's position. During that period deals originating in other branches are passed to the current book manager for local completion. New York passes its Japanese "book" of security trading onto Tokyo. Another stock "book" is traded via Hong Kong instead of Tokyo; still others shuttle between only two cities. For example, most U.S. stocks are traded largely by the Merrill offices in the U.S. and London because they remain thinly traded in Japan. This type of global trading is telecommunications intensive, since traders in passing the "book" need to swap information on the latest developments (Anon, 1987).

However, it is unlikely that this type of global securities trading will become the norm. Local securities markets continue to be the key centres in driving the prices of companies; the greatest liquidity for most companies' stocks continues to be in their local market. While it is possible to buy Japanese stocks in London and later the same day sell them in New York, the price of Japanese stocks will be driven from Tokyo, not London or New York.

There are many other problems inhibiting the rise of global securities trading. Most securities are not as international as U.S. bonds, and few dealers can achieve the global coverage of Merrill Lynch. Equities in particular are hedged around with a maze of regulatory and settlement problems. Clearing and settlement of each trade presents a major problem and there are foreign exchange risks inherent in any delay.

Twenty-four hour trading may also be achieved by linking financial exchanges located in different time zones. For example, futures exchanges in different countries have linked contracts in a mutual offset system: thus, a contract bought in Chicago may be sold in Singapore without additional commission fees. A number of other futures exchanges are planning to establish similar links. The advantage of the system is that it is possible for a contract to be bought or sold over a longer period of time in any day; this reduces uncertainty since many financial markets show major fluctuations on an hourly basis.

While a number of linkages have been developed and some are quite successful, many others have never moved off the planning stage.

There are a variety of technical and regulatory problems in linking exchanges. Regulatory difficulties are a particular problem in a number of cases. However, one of the major problems relates to the competition between exchanges; each exchange wants to hold its own business. The exchanges are less keen on internationalisation than their clients. Larger exchanges fear that a link with a smaller exchange will sap liquidity and provide no real benefit for their own market. Smaller exchanges fear that they may be swallowed up by the larger exchange, although they would not be interested in linking up with other small exchanges. In addition, there may be conflicts between large versus small traders and brokers (Nicoll, 1985). However, a factor encouraging cooperation between different exchanges is the threat from electronic trading systems promoted by Reuters and Telerate.

Major futures exchanges in the Asia-Pacific region (Tokyo, Singapore, Hong Kong and Sydney) are competing with each other to attract business from North America and Western Europe during the hours that the latter exchanges are closed. Conversely, these Asia-Pacific exchanges are also facing competition from U.S. and European futures exchanges, which are expanding the number of hours they operate each day in order to attract trade from the Asia-Pacific Region and from each other. While it appears that the potential business resulting from twenty-four trading has been exaggerated, there is growing competition between exchanges, particularly between Chicago and Tokyo.

The computerization of futures exchanges has been stimulated by the internationalization of the industry. The Chicago Mercantile Exchange and Chicago Board of Trade are considering merging their computer trading systems. The merger has been stimulated by the threat of Japanese exchanges. Other futures exchanges, such as the Sydney Futures Exchange and in Europe (London's LIFFE and the French MATIF) have also plans for electronic exchanges.

5.2 EXTENSION OF EXCHANGES' OPERATING HOURS

Some stock and futures exchanges have expanded the hours that they operate in order to improve their competitive position. This strategy may be seen as an alternative to that of linking exchanges. For example, the extension of trading hours for large U.S. futures exchanges offers the prospect of world-wide dominance for particular contracts, as opposed to shared dominance with exchanges in other time zones.

Chicago Board of Trade and the Philadelphia Stock Exchange have extended trading into the evening. Chicago's plan was to tap Asian investors who are large buyers of U.S. Government debt. The Chicago exchange will overlap with Tokyo by staying open to 9 pm Chicago time. The Chicago Board of Trade has also opened earlier in an attempt to capture business from Europe. The drawbacks of longer hours are high costs of employing staff outside normal working hours and thin liquidity. One way around these disadvantages is to use electronic trading in hours outside normal trading.

5.3 ELECTRONIC EXCHANGES

There has been considerable interest in the possibility of establishing electronic alternatives to the physical futures and securities markets. The best developed scheme is GLOBEX, jointly developed by Reuters and the Chicago Mercantile Exchange and due to start in the first half of 1990. GLOBEX will allow traders and their customers to deal using their screens in the financial futures and options contracts of the Chicago exchange for the 16 hours each day when there is no dealing in Chicago (Wolman, 1987). GLOBEX will automatically match orders at the best price as they come in. This development avoids the costs of operating a physical exchange twenty-four hours a day and the regulatory and institutional problems of trading "following the sun". Other futures exchanges have expressed interest in joining GLOBEX and using it while their exchanges are closed. Reuters is likely to be in a strong position, given that there will be a substantial amount of telecommunications traffic generated twenty-four hours a day from its operations for futures exchanges in different countries. There are a number of other electronic trading schemes. LIFFE and the Sydney Futures Exchange have their own local electronic schemes for after hours trading, although the Sydney Exchange may also join GLOBEX as well.

6. CONCLUSIONS

Internationalization of the banking and financial industry has major implications for the telecommunications industry. While there are substantial variations in the nature and degree of internationalization in different parts of the banking and finance industry, there can be little doubt that the "global jigsaw puzzle" associated with the internationalization of banking and finance will require massive international telecommunications flows. Rapid growth of Asia-Pacific economies is likely to result in further internationalization of key industries and further growth of telecommunications traffic.

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Session 6.6

Questions To and From the Future

Panel Discussion

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Wednesday, January 17

Closing Plenary

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